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Our Use of Air Power

The GHQ Air Force as an Instrument of Defense

By Maj. Gen. F. M. Andrews*

THE air power of a nation is defined as "its capacity to conduct air operations; specifically, the power which a nation is capable of exerting by means of its air forces." Examples of application of air power include the air attack of such objectives as enemy air forces, troop concentrations and columns, critical points in lines of communications, naval vessels, supply ships, and transports. Some of the objectives mentioned are within the sphere of influence of friendly ground forces, while others are not. The attack of those objectives that are within the sphere of influence of friendly ground forces constitutes direct support of the ground forces. The attack of others is by independent air operations, which are always coördinated by the Army High Command and which contribute indirectly, but none the less effectively, to the success of the Army as a whole.

To understand air power, it must be realized that the airplane is not just another weapon. It is an engine of war which has brought into being a new and entirely different mode of warfare—the application of air power. It is another means, operating in another element, for the same basic purpose as the application of military power or sea power—the destruction of the enemy's will to fight. The true object of war has never been merely to defeat an army or navy. Such defeat is only a means to an end. That end is the destruction of the enemy's will.

Air power can be applied *directly* against the objective sought without first having to overcome barriers and obstacles such as swamps, rivers, mountains, and most enemy surface forces. The principal obstacles to be overcome in the direct application of air power are weather, antiaircraft defenses, and distance. Weather has already been overcome to a great extent. In fact, landings and take-offs in dense fog and the elimination of ice, which have been the most serious weather dangers of the past, will soon be commonplace. Antiaircraft defenses often can be avoided due to the difficulties of interception and of forcing combat on a force capable of moving in three dimensions. Antiaircraft defenses tend to become less formidable because of the tremendous increase in speeds and altitudes of modern bombardment and because of the wide choice of suitable objectives with the consequent impracticability of defense of all. Distance alone remains and that too is being overcome rapidly.

That air power is now a major concern of foreign governments is plainly indicated by developments in the armaments of all great powers during the past year. Today in Europe where major powers are contiguous or not far distant, the threat of the direct application of air power to civilian populations and political centers is giving "the jitters" to responsible statesmen in all these countries. These developments have had in each case a most intimate effect upon sea power. The effect upon military power has not been quite so apparent. The current sentiment in England upon this subject is very well expressed in the August 1936 issue of the *Journal of the Royal United Service Institution* as follows: "Aircraft gravely threaten the ability of the Navy to control sea communications, particularly by their power of destroying the security of ports and bases. The only really effective method of affording such bases reasonable security is our own definite superiority in the air. The provision of such superiority is a definite duty of the air defense organizations of the Empire. The general success of the air campaign, as a whole, will provide the necessary security for the functioning of our ports and bases, without which the naval organization for exercising actual control of the vital sea communications cannot function and the life of the United Kingdom cannot continue." Our nation should consider the possibility of being faced with a similar situation.

THE development of modern aircraft can be foreseen clearly for the next five years and portends great possibilities in future construction beyond that period. This vision reveals aircraft of such capacities in range and load characteristics as possibly to place this country, now so fortunately located geographically, in a predicament somewhat similar to that in which all European countries now find themselves—with no air frontiers. We have been complacent in viewing without alarm this predicament of European countries, but no one can foresee what may happen in aviation beyond the next five years. The only thing we can do about it is to admit the possibility and apply our national ability to the proper development and utilization of the potential air power of this country to the end that we shall at least be a little bit better than the other fellow at all times. It is to our best interests to continue to maintain our enviable position as the pacemaker in aëronautical developments, for by so doing we are always in advance of anything that a foreign nation can produce. The mere possession, in sufficient numbers, of superior tools for any job always exercises a profoundly sobering effect upon any competitor. We should not wait until tomorrow. Air power is today's concern. To consider the potential resources of our country as a substitute for an actual air force is an error. The air power of a nation is what it actually has in the air today. That which is on the drafting board and in the statistical tables of resources and man power

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cannot become its air power until five years from now—too late for tomorrow's employment.

I will not review in detail the tools which implement air power. It will serve a good purpose, however, for me to point out a few of the peculiarities inherent in their employment. The Army is responsible in all situations for the direct defense of the coast. The Air Force, due to its ability to engage an enemy approaching our coasts when still far at sea, will normally be the first element of the Army to be thrown into action by the Army High Command. This will mean the use of an arm which has no flanks and no rear and whose logistics are different from those of any other arm. It will also mean waging a defensive war with weapons that cannot take a defensive stand. The commander will know that defensive missions can be accomplished only by the most aggressively offensive action. He will know that if he is successful in gaining a decision with his air forces, the task of the ground arms will be greatly simplified. And, if successful, he will enjoy the reaction attendant upon the knowledge that he can dominate vast areas without the customary military necessity for complete occupation thereof.

Photograph by U. S. Army Air Corps.

MAJ. GEN. F. M. ANDREWS, AIR CORPS, U. S. ARMY, COMMANDING GHQ AIR FORCE

IN view of the tremendous influence of aviation on any war of the future, enemy air forces in flight and at their bases will always be an important objective for our own air forces. As all effective air operations must be conducted from well-prepared and organized air bases, it follows that the first mission of our air forces usually will be to deny to the enemy, through independent air operations, any suitable bases, floating or ground, from which he might operate. It is to that end that we are designing our bombardment organizations and training our personnel. We are emphasizing navigation training in our units today, and we already have a considerable number of excellent celestial navigators. And, in order to be able to strike any bases from which an enemy might launch attacks against us, we obviously can never afford to fall behind other nations in the performance of our airplanes.

To defend against air attack some may ask, "Why not rely on antiaircraft defense—pursuit aviation and antiaircraft guns?" I believe that pursuit aviation is an effective antiaircraft weapon, but building into it the characteristics which make it effective—speed and a high rate of climb—reduces its range until it is a weapon of local defense only. It is obviously impracticable to provide sufficient pursuit planes or antiaircraft guns to defend any but the most important areas. There are too many targets available to an enemy's long-range bombardment ever to defend effectively in this manner, and in addition, pursuit interception without the aid of a very elaborate system of antiaircraft warning service is largely a matter of chance. Air attacks cannot be stopped by any means now known. Victory will accrue to the side which can strike the hardest blows and at the same time endure the air attacks of the enemy. England, even with an elaborate warning service for the defense of London and a concentration of vulnerable points much more dense than ours, is reorganizing her Air Force with a considerable preponderance of bombardment over pursuit. The main reliance to defeat an enemy air force must be bombardment aviation directed against his bases and airplanes on the ground.

Though air operations against an enemy air force by air attack of his bases is an outstanding example of independent air-force action, there are numerous other examples of independent air missions which might be listed. Such air-force missions are independent of ground forces tactically only. Strategically, they must always be closely coördinated and controlled. Commanders of ground troops must know what type of air operation is best suited to meet the situation. They must neither recommend nor direct air operations that are either unsuited to meet the situation or that are beyond the powers of the air forces to execute effectively. Similarly, commanders of air forces must be conversant with the method of operations of the various arms of the ground forces to be able intelligently to recommend and execute such air operations as will afford the most effective support to the ground forces.

NOW let me describe our GHQ Air Force. It was conceived and its creation recommended in 1933 by a War Department Board which comprised outstanding general officers of the Line and the Chief of the Air Corps. The board reached the conclusion that the minimum airplane strength required by the Army Air Corps was 2320. It recommended that 980 of this number be assigned to the GHQ Air Force. It allocated the remainder to the foreign possessions, to training, depot overhaul, and miscellaneous. The following year the Secretary of War convened another board known as the Baker Committee, headed by the Hon. Newton D. Baker, Secretary of War under President Wilson during the World War. In addition to other outstanding civilians, the Baker Committee, like the War Department Board, comprised general officers of the Line and the Chief of the Air Corps. The Baker Committee also recommended 2320 airplanes for the Army Air Corps and recommended the creation of a GHQ Air Force. The Seventy-fourth Congress in 1936 authorized the airplanes.

On March 1, 1935, the GHQ Air Force was formed, pursuant to the War Department Letters of Instruction dated December 31, 1934 and February 19, 1935. The ensuing year was designated as a period of service test of its organization. The GHQ Air Force comprises all units of attack, bombardment, pursuit, and reconnaissance aviation in continental United States. Prior to its organization, there was no centralized direction of air combat units and insufficient coordination and direction of tactical thought and doctrine. The new organization was intended to provide centralized control and coördination, and it has done so. To this end and to secure the proper amount of decentralization, the original organization of the GHQ Air Force set up three wings. The First Wing—on the West Coast—comprises two groups of bombardment, one group of attack, and two squadrons of reconnaissance. The Second—on the East Coast—comprises two groups of bombardment, two groups of pursuit, one squadron of attack, and two squadrons of reconnaissance. The Third Wing—at Barksdale Field, La.—comprises one group of attack and one of pursuit.

Photograph by U. S. Army Air Corps.

BARKSDALE FIELD, LA., HEADQUARTERS OF THE 3RD WING, GHQ AIR FORCE

ONE of the primary underlying reasons for the creation of the GHQ Air Force was the requirement for a highly mobile and powerful striking force that could be moved quickly from one part of the country to another. In order to secure mobility, the original organization consisted of very small squadrons, each with barely sufficient men to operate the airplanes assigned, on the assumption that practically all service and maintenance would be performed for them by service echelons. The service echelons consisted of mobile service squadrons—part of the GHQ Air Force—and station complements, fixed and immobile, under the control of the various corps area commanders. The station complements were not a part of the GHQ Air Force. The year of service test showed to the satisfaction of all concerned that the original organization needed revision in several respects. The principal changes effected by these later directives were to abolish station complements and service squadrons, to create base organizations, and to place under the Commanding General, GHQ Air Force, all activities at GHQ Air Force bases instead of retaining parts of these bases under the control of corps area commanders.

The present organization of the GHQ Air Force comprises the three wings as before; somewhat larger combat squadrons with complete combat crews and more maintenance and housekeeping personnel, and group headquarters and headquarters squadrons. New organizations, called Air Base Squadrons, have been created at the various GHQ Air Force bases to take over the duties hitherto performed by the station complements and such duties of the service squadrons as are not assigned to combat squadrons and to headquarters squadrons. There are no approved tables of organization for the GHQ Air Force. Tables of organization prepared by the GHQ Air Force Headquarters are now being studied by the General Staff. Based on these tables, all tactical units are now operating at greatly reduced strengths on personnel allotment tables. Service organizations from the Quartermaster Corps, Signal Corps, Medical Department, Ordnance Department, and Chemical Warfare Service are all component parts of the Air Base organization. In the use of service troops, I believe the GHQ Air Force goes further than any other arm. Almost all transportation service, except air transportation, is to be furnished by Quartermaster troops, and accordingly but little transportation has been assigned to our tactical units. Ordnance responsibilities for ammunition and bombs extend right up to the airplane itself. Pooled service is the principle upon which our base organization is constructed.

The Army has made a great deal of progress in the organization of its air forces within the last two years, but there remains much to be done in addition to organization to attain in proper balance and in reasonable time the program recommended as a minimum requirement by the War Department Board and the Baker Committee. With respect to the GHQ Air Force, the most striking deficiency is the shortage of airplanes. There were originally assigned to the GHQ Air Force a total of but 342 combat and cargo airplanes, of which only 164 were modern. At this time, the number of airplanes has been increased but little. The replacement needs of the overseas possessions and of other activities of the Air Corps, along with the requirements of the GHQ Air Force, will largely absorb the new airplanes being purchased. The quality of airplanes assigned, however, is greatly improved, and within a few months it is hoped that all the obsolescent airplanes with which the GHQ Air Force was largely equipped when first organized will have been replaced by modern models.

The shortage of commissioned officers parallels that of airplanes and is even more acute. Only 409 Regulars out of the approximately 1350 in the Air Corps were allotted to the GHQ Air Force on June 30, 1936. The bulk of the 1350 is absorbed by the overseas garrisons, the establishments under control of the Chief of the Air Corps, the several service schools, and by miscellaneous other requirements. The lack of experienced officers for key positions in our combat units constitutes one of our gravest handicaps. It affects combat efficiency and accident rates; for example, our bombardment airplanes, more complicated and at least as powerful as any commercial transports, have been operated frequently by cadets and Reserve officers as airplane commanders with far

less flying experience than is required of even a copilot on a transport line. Shifting of personnel has improved this situation somewhat by assigning the less experienced pilots to single-engined airplanes. Tactical squadrons, with nine or ten key positions, are trying to get along with only three or four experienced officers. It is dangerous, uneconomical and inefficient to intrust modern complicated and expensive airplanes to inexperienced pilots.

Our Reserve officers on extended active duty have augmented the numbers of pilots on duty with the GHQ Air Force to a total of approximately 700 on June 30, 1937. These Reserve officers are splendid young men and are skillful in handling an airplane, but assigned as they are, and must be, immediately upon receiving their "wings" at the Air Corps Advanced Flying School, they do not have the practical experience either in flying or in the ground duties of an Air Corps officer to compensate for the shortage of Regular supervisory personnel. They need close supervision while they are acquiring experience.

Photograph by U. S. Army Air Corps.

BOMBARDMENT GROUP, GHQ AIR FORCE, LINED UP FOR INSPECTION

LAST June, Congress authorized a lengthening of the tour of duty of Reserve officers to five years, and authorized 1350 of them for the entire Air Corps. Lengthening the tour will increase the efficiency of the GHQ Air Force as it will reduce the turnover of pilots and permit their retention on active duty beyond the period of acquisition of experience. The former short tour required the discharge of a young officer at the very time when he was beginning to know his job. This substantial increase of the number of Reserve officers has not been entirely provided for.

The enlisted situation, unless relieved, will become as serious as that of the officers and airplanes. Enlisted men are vitally needed as mechanics, gunners, radio operators, parachute riggers, and the many other trade specialists necessary to an air force. There were assigned on June 30, 1937, only 7141.

By July 1, 1938, with the expected increase in airplanes on hand, the situation as indicated by the following numbers will be a little short of desperate unless relief comes:

Air Corps Personnel	*Required*	*Assigned*	*Shortage*
Regular Officers	718	442	276
Reserve Officers	393	338	55
Enlisted Men	7,929	7,141	788

In addition to the shortages of airplanes and personnel, there is a shortage in air bases, but the present Congress has authorized funds to construct a new air base near Tacoma, Washington. Air bases in all strategic areas have been authorized by the Wilcox Bill (Public No. 263, H.R. 7022, Seventy-fourth Congress) and are required. I have already noted that a main reason for the creation of the GHQ Air Force was to endow the air combat units in continental United States with strategic mobility. But such mobility cannot be secured through organization alone. Properly prepared and adequately manned air bases are also essential, for any air force is practically immobile strategically without them. The air-base system is in no way a cordon defense. Quite the opposite in fact, for an air force becomes strategically mobile only when bases have been previously prepared for its accommodation. Should it be desired to concentrate the GHQ Air Force units in a distant theater, the airplanes would fly with their combat crews, and the nonflying echelons of squadrons, groups, and higher headquarters would be transported in first priority by air, motor, rail, or ship, to the bases serving the new theater. Base services for the incoming units would be furnished by the base personnel in the concentration area as an overload until such time as base personnel from the bases rendered inactive arrived to reënforce the bases serving the concentration.

What is this air base we stress so strongly? An air base is a *command* which comprises the installations and facilities required by and provided for the operation, maintenance, repair, and supply of a specific air force. An air base will, as a rule, cover a *considerable area,* especially if the installations and facilities must be dispersed because of terrain, security, or other considerations. An air base is much more than a mere peace-time garrison or home. Modern aircraft cannot operate from cow pastures. They require previously prepared air bases for their maintenance and operation. All stations of GHQ Air Force units are nuclei for air bases, and it is expected that certain of them, if not all, will operate as such in war time as well as in peace.

A TYPICAL air base comprises, at base headquarters, an airdrome together with permanent shops, warehouses, communications, and other necessary facilities. It includes, in addition, such necessary auxiliary airdromes as can be serviced by the base. These auxiliary airdromes will be used normally for the operation of squadrons from the home base or those brought in from other bases, and initially will have few fixed installations other than landing surfaces. An air base exists for the primary purpose of providing the services necessary for the operations of combat units. In addition to the supply of clothing, food, and other items common to all arms, air bases must furnish such essential Air Corps services

as technical supply, parachute maintenance, photography, maintenance engineering, weather service, radio range, airdrome lighting, bombing and gunnery ranges, etc.

The services performed by air-base personnel are concurrent and integral with the daily training and operations of GHQ Air Force units. The requirements for base personnel and services will be greater in war than in peace, as in war many Air Force tactical units will operate from auxiliary airdromes with reduced permanent facilities and installations.

With respect to GHQ Air Force operations in coast defense or in other joint operations, it should be realized that when the Army was composed almost wholly of land forces and the Navy of sea forces, the problems of fixing the respective responsibilities of the two services and of coördinating their operations, were comparatively simple. With the inclusion of air forces as an integral part of each service, the problems of dividing the responsibility between the land forces, the sea forces, and the air components of the two services, and of coördinating land, sea, and air operations, have become more complex. While only in special situations can land forces influence sea operations, and sea forces directly influence land operations, air power may exert a considerable, and possibly a decisive influence on all phases of both land and sea operations.

Photograph by U. S. Army Air Corps.

BOMBARDMENT AIRPLANES, GHQ AIR FORCE, AT LANGLEY FIELD, VA.

All GHQ Air Force bases now have been placed under the GHQ Air Force commander on an exempted-station status to give him control of the means required daily in the operations and training of his units. This decision is a logical compliance with the principle of unity of command.

IT is hardly necessary to discuss here GHQ Air Force operations in direct support of ground forces as they are so well understood. However, I desire to stress my belief that the bombardment airplane is and must be the backbone or principal element of any air force, whether acting "independently" or in close support of ground forces. Fortunately, the modern bomber, particularly as exemplified by the Boeing 4-engined B-17 popularly known as the "Flying Fortress," is a very flexible fighting machine. While designed to carry medium loads of bombs to distances beyond the sphere of influence of ground forces, it can of course carry these same and greater loads to all distances within the sphere of the ground forces. Fuel loads and bomb loads are now interchangeable to a certain extent, and every effort is being made in Army airplane construction to provide an even greater degree of interchangeability. For short-range missions, the object in providing very heavy loads is twofold: to permit either a stronger blow with the number of bombers on hand, or the delivery of the required blow with only a few of the bombers. They can leave their bombs behind and, by substituting extra tanks of fuel they become splendid long-range reconnaissance airplanes. The modern 4-engined bomber per ton of bombs carried is cheaper in first cost and in upkeep and more economical of men for operations and maintenance. It is much less likely to be forced down from engine failure or destroyed by enemy pursuit. Its great speed confers a high degree of immunity from anti-aircraft fire and increases the chance of securing surprise. It is without peer for short-range close-support bombardment missions; for long-range, "independent" operations; and for long-range reconnaissance. It is truly a remarkable tribute to American engineering talent, and to the broad vision and the professional application of those who encouraged its development.

The employment of the GHQ Air Force in support of naval operations is principally a matter of common sense and practical application. If the naval situation at any time should be the critical one for the nation, and the Army could assist by any means at its disposal, it most certainly would do so. The medium of the airplane is the air and its personnel must be trained to operate against any targets—whether on land or water. Bombardment aviation is effective against anything afloat, and the training of the GHQ Air Force is designed to increase that effectiveness.

THE direct defense of the coast is the Army's responsibility. In this responsibility, bombardment aviation is a vitally necessary weapon. In some situations it is the only usable one. So far as the United States is concerned, with friendly neighbors to the north and south of us and great oceans on the other sides, bombardment airplanes are weapons of pure defense and not of aggression. They cannot wage offensive war against any enemy within his own territory, but they are a powerful deterrent to any enemy who would cross the oceans to attack us.

The use of the Air Force in coast defense will, of course, be a combination of independent missions of bombardment and—as the enemy comes within the sphere of influence of ground arms—of close-support missions. In this connection, I cannot conceive of any enemy attempting a landing on our coasts without first gaining air superiority. A landing on a hostile shore has always been a hazardous undertaking, and with the advent of air power its difficulties are tremendously increased.

In the Italo-Ethiopian War, if Ethiopia had had an effective air force, the outcome might have been very different. The Italians used two seaports for their operations

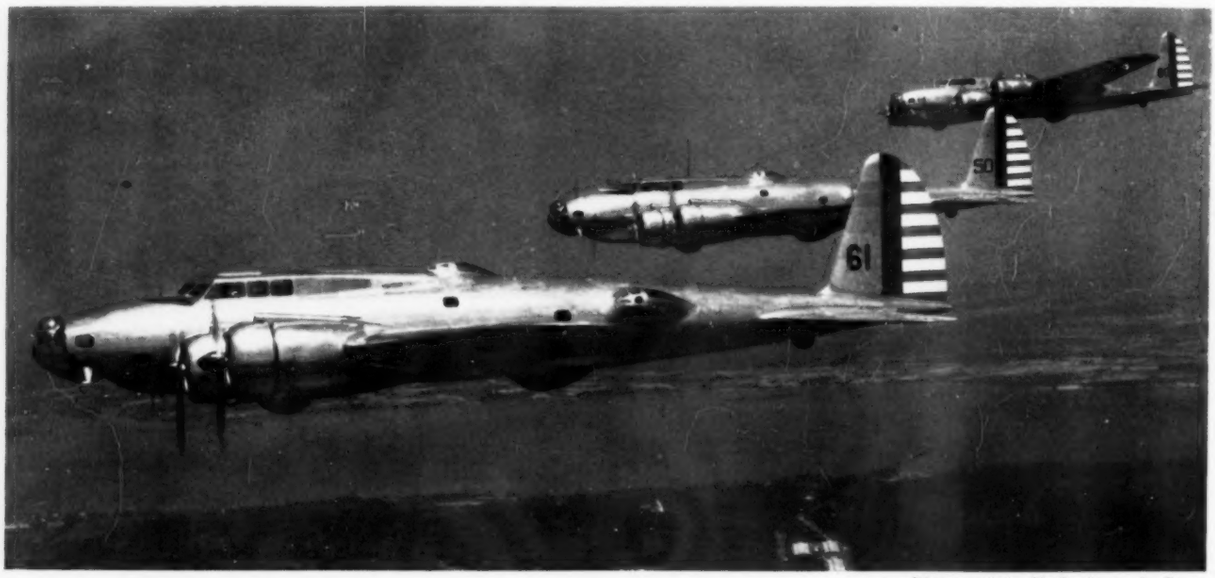
against Ethiopia—Massawa and Mogadishu. The principal port was Massawa, on the Red Sea. Prior to the war, the capacity of this little port is said to have been but 300 metric tons per day. Before the Italian operations reached their peak, the daily capacity of this port had been expanded to 4500 metric tons. About 2000 metric tons per day were hauled by truck from base to front over a tortuous 1-way mountain road (up for twelve hours and down for twelve hours). The remaining tonnage was stored in vast dumps at the port. Such a target would have been ideal for Ethiopian bombardment aviation had there been any, and would have required a tremendous amount of Italian effort for its protection.

The port used as a base for the Southeastern Italian forces was Mogadishu, on the Indian Ocean. This port, I understand, is nothing more than an open roadstead, not usable during certain seasons of the year. All cargoes were unloaded from ships to lighters and thence to shore. A force of bombers from airdromes located centrally in the vicinity of Addis Ababa probably could have denied to the Italians the use of both of these ports.

There was little opportunity for the employment of Italian bombardment aviation in its true rôle of providing indirect support to the ground forces by the disruption of supply and transport systems in the rear areas, for such systems did not exist in semibarbarous Ethiopia. However, Italian aviation rendered incalculable assistance to the ground forces by guarding against surprise, by breaking up concentrations and attacks, by exploiting pursuits, and by transport of troops and supplies.

It is pertinent here to add a few additional remarks, largely from the tactical and strategical point of view, with reference to the necessity for large airplanes for reconnaissance and bombardment. Large airplanes can reënforce Alaska, Hawaii, and Panama by air from the United States. From there or from the United States one of their most important missions would be to deny to the enemy the use of any base he may attempt to seize. They should also be able to afford invaluable support to our fleet in its operations against an enemy fleet. These are the primary contributions of air power to defense, and are essential forms of action which no other military forces can undertake.

THE statement is sometimes made that the modern airplanes now being purchased are so much more powerful and effective than those envisaged by the Baker Committee, that the numbers necessary are less than those recommended. That may be so, but no new numbers can be arrived at without an exhaustive estimate of the world situation. Every major power has greatly increased its air force, both in quantity and quality. It is not at all certain that this estimate of the situation would not show the need for still greater numbers, even though our modern airplanes are more powerful than they were formerly.



Photograph by U. S. Army Air Corps.

FIRST "FLYING FORTRESS" FORMATION IN ECHELON

In conclusion, I have attempted in this short article to give readers of ARMY ORDNANCE the high lights of the problems and powers of the GHQ Air Force as the instrument of defensive air power in continental United States. The organization of the GHQ Air Force has made tremendous strides, and it has greatly increased its proficiency in communications, flying, navigation, bombing, and shooting, but we realize that there is still plenty of room for improvement. It requires so much time to build airplanes and to train personnel that the provision of adequate means for the GHQ Air Force cannot be delayed until war is imminent. The GHQ Air Force must of necessity be an M-day force to be essentially ready to commence independent air operations upon the declaration of war. We are far short of that objective at the present time, but the responsible authorities of the War Department are fully alive to the situation, and I truly believe that the forthcoming year will see real progress toward the provision of the necessary airplanes, personnel to maintain and fly them, and bases from which to operate. These steps must be taken now, in time of peace, if we are to meet our responsibilities for the development of our country's air power. To delay would be to deny ourselves the services of a most potent factor in national defense at the very time when it would be most effective—the early stages of a war of aggression against us.

Preparedness in England

A Study of Industrial Mobilization, I

By L. A. Codd*

ENGLAND today is arming against war on a scale never before undertaken by a democracy not actually engaged in hostilities. The reasons why she is doing so are clear enough. Her empire of nearly 494,000,000 people must continue to exist as an empire in the face of threats from many sources. To guarantee that existence, England at last, after nearly twenty years, has forsaken persuasion solely by word of mouth for reliance upon preparedness jointly by force of arms. Today she is spending at the rate of $4000 a minute upon a 5-year program of defense which will cost at least seven and a half billion, and more nearly ten billion dollars. Her budget for national defense for the current 12-month period (to March 1938) is $1,391,335,000. Three pronounced results are already apparent: her rearmament progress is decidedly great, her unemployment is decidedly small, and the probability of a major war in Europe is halved.

THIS is the first of a series of articles on industrial mobilization in England. Convinced that the present preparedness program upon which England has embarked is of particular significance, the Directors of the Army Ordnance Association commissioned the Editor of ARMY ORDNANCE *to visit England and study at first hand the factual position of that great country's rearmament plans. The study is not concerned with the specific types or quantities of equipment now in production. Rather, its purpose is to present to readers of this journal an analysis of the principles, methods, and policies now being used for the mobilization of England's peace-time industry to meet a defense program which far exceeds any previous undertaking by a democracy short of actual mobilization in war. Because this program is fraught with meaning for the progress of industrial preparedness in the United States, these articles are presented as an important object lesson for our study. Other articles, in complete series, will be published in succeeding issues.*

To me, as an American observer who has come to England to study the industrial-mobilization phases of her program, there is a deep feeling of respect and admiration for this resurgence of British tenacity. The Lion has awakened again and, somewhat late, is now looking to conditions which are very real. The awakening was abrupt but none the less thorough. How abrupt and how thorough is shown by the following episode—one of many.

Two years ago more than eleven million men and women of England voted aye on a so-called "peace ballot" which was jampacked with pious platitudes for collective security and shocked sentences against the use of force for the preservation of her national well-being. The League of Nations Union, pacifists, and Laborites were a great factor in the voting.

As I write these lines in mid-September, so complete has been the right-about-face, that the Trades Union Council in national convention at Norwich has adopted a report of the National Council of Labor (a joint statement of the T.U.C. and the Labor Party) to the effect that rearmament can no longer be delayed. The vote was 3,320,000 for rearmament and 224,000 against. Even Lord Cecil, father of the "peace ballot" of two years ago, now grants "the loathsome necessity of rearmament."

Like many other Americans, I know the Englishman's historic love of pageantry and his respect for tradition. Today these take on a newer meaning. There is proof aplenty that the colorful troops, now making their daily march beneath my hotel window for the changing of the Guard at St. James' Palace, are more than a symbol of English tradition. They are a sign of a reawakened British Lion in whose manner strength rather than weakness is the keynote.

BUT it is not my purpose in this series of studies to consider the political or the international significance of England's new defense attitude. One can agree with it or disagree as he chooses. (The only disagreement I have heard here during the past few weeks was at Hyde Park, where the soap-box orator was none too critical.)

My purpose is much simpler and, I hope, more to the point. Briefly stated it is this: We of the Army Ordnance Association are a body of American citizens "pledged to industrial preparedness as our strongest guaranty of peace." We have been sponsoring that doctrine for the United States for nearly twenty years. Every lesson we draw as to methods of procedure toward the full utilization of our industrial power for the national security has its basis in our World War experience. When we speak of the folly of nationalization of arms production we go back nearly a generation for our proofs. When we demand that industrial-mobilization planning be kept in the forefront of our national-defense policy we turn for examples to our own tragic lessons of 1917-1918. When we plead for sympathetic sponsorship of our National Defense Act, or when we praise the wisdom of our 1936 Industrial Mobilization Plan, or when we urge the necessity for close coöperation between American industry and our national defense, always we go back to the lessons of "the war" and earlier. We have no other experience of great arms production on a national scale upon which to base our judgment. In such a process, we realize that our theory at times may become academic, and the practical occasionally may be overlooked. At the same time we speedily admit that our national-defense needs are ever changing. No group is more sincere than ours in the belief that tomorrow's war will not be yesterday's.

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Hence, there should be much for us to learn from England's present program. It is an experience twenty years older than ours, and it has the benefit of years of progress in theory and in practice. England, of all the nations of the world, is more nearly like our own in her culture and her civilization. She is governed by the governed—at least as much as we are. England and the United States have a similar regard for personal and property rights, for law and order, for individual freedom—and for national defense. Both countries lose their defense perspective periodically but not for long. The United States has her Cecils and England has her Nyes. But both countries are fundamentally far too practical and realistic to take much stock in the stark idealism of the one type or the shabby sensationalism of the other.

Indeed, there should be much for us to learn from England's present program. How is she going about it? What principles of organization has she adopted? What methods of planning is she using? What policies govern her relationships with private industry? What procedure has she determined upon for munitions design and production, for matériel supply, for allocation of facilities, for survey of industry, for prompt production? And, in her contractual procedure, what steps is she following "to take the profit out of war"? Surely, if we can find the answers to these and hundreds of other allied questions for our own study and application, we of the Army Ordnance Association will have made a timely contribution to our own national defense. We need not reassert our conviction born of fact: Industrial mobilization is more than ever before the crux of all national defense. We proved that twenty years ago; now England is proving it again.

THE arms program in England today has two phases. The first phase goes by various names, all indicating its *immediate* nature. It is called "the deficiency program," or "the reconditioning program," or "the expansion scheme," or plain "rearmament." Regardless of title, it is that part of the general policy which has for its immediate purpose the building up of those military stores which, after years of attrition and meager replacement, were all but exhausted. It is a program of modernization, mechanization, replacement and war reserves.

We at home know something of this experience. We likewise, for far too many years, saw our military and naval resources dwindle when our statesmen talked and our conferences "limited," the while our Navy dropped below treaty strength and our Army went prewar. Making up for lost time has given us a national-defense expenditure of a billion dollars this year. Navies, if we are going to have them at all, must be kept up to the mark, armies must be trained and supplied for current needs and for reserve. And when we let those insurance policies lapse, we cannot reinstate them without paying what is past due. We know that to our sorrow and so does England. Making up for lost time is urgent and it is England's *immediate* task.

In this, her problem is far more complicated than ours because she does not seem to know yet what her man-power curve—and consequently her initial requirement, plus wastage, plus replacement, plus ultimate effort—must be. But more about that later. Suffice it to say that in this immediate phase of her rearmament, England's Government and British industry are in partnership—Government factories and private plants throughout the land are busily engaged in the production of deficiencies for the Admiralty, the War Office, and the Air Ministry. The measures taken have the secondary beneficial effect of reducing unemployment. Making up deficiencies, then, is the first phase. It relates to the present; it is immediate—and it is further along than most people think!

THE second phase of England's armament program is of the *future*—it is her scheme for industrial-mobilization planning. It is the part which will carry on after present deficiencies have been met. It is the program of readiness for armament production. In many respects it is quite different from what has been planned for the United States, and where the two schemes are similar, England's has some features ours lacks.

For the future of preparedness, *i.e.*, her "war potential," England has turned to the "shadow factory"—a reserve source of private industrial supply (plant, equipment, and personnel) to be available indefinitely in case of emergency. Under this policy, a number of private companies which ordinarily do not make warlike stores have been selected as shadow factories by reason of the firms' allied commercial experience and their possession of a skilled staff of engineers and workmen. Once chosen, arrangements are made for building or expanding the necessary plant and for installing machinery for a given output of selected articles. Sufficient orders will be provided in peace time to provide training—or shall we simply use our American phrase, "educational orders"—in munitions production.

Many of these shadow plants are built, others are in course of being built. And note the latitude under which the shadow-factory policy will operate. On this point the authoritative attitude of the Government is that "the particular circumstances will vary in connection with every firm and with different types of product. Wide elasticity of arrangements must therefore be provided for, but the underlying principle is that each selected firm, while maintaining and developing its normal civil trade, will agree to use its organization and commercial structure to set up some measure of munition production and thus create the reserve source of supply."

Shadow factories have been or are being built for the production of aircraft and certain types of ordnance. At the same time, existing Government factories for the production of fuzes, bombs, mines, torpedoes, explosives, propellants, and loading plants are being extended or duplicated. In this latter connection, vulnerability of site and the needs of the "Special Areas" (those regions in England, Wales, and Scotland where economic development and social improvement are being particularly fostered) are given special consideration.

WITH the above broad division of the program in mind, we must get some basic conception of England's naval, military, and air defense organization. And that will be difficult at best. First off, we must forget all about our own type of organization, because the two are as unlike as a Chicago cop and a London bobby. The organization is different, the way of doing things is different, the approach is different. Let me give a few simple reasons why I believe this is so, for there can be no doubt that it is so.

The reasons go deep into the differences between the

American way and the British way of doing things. *A* passes a thousand and one laws a year for doing a thousand and one things—good, bad, and indifferent; past, present, and future. *B* does not; she passes few laws and then only as needed and seldom if ever beyond the immediate necessity. Once passed, those laws have teeth; they say what they mean and mean what they say. *B* crosses her bridges only when she comes to them. Lord Macaulay said that in finer phrases years ago, but it is still the rule.

Again, *A* is essentially formal—the slide rule, the organization chart with finely divided lines of authority, specific delineation of duties, clearance by this echelon and then the next higher, and no action until highest authority has signed and sealed—all these *A* has developed to the highest degree and follows faithfully in Government and in industry. The *A* genius for organization works that way. *B's* does not to anything like the same degree. The conference, or the luncheon table, supplemented by the telephone and augmented by a small, closely integrated organization, shifting quickly to meet the problem in hand—such informalities are especially *B's* way and for *B* they work.

Again, industrially *A* is spread out; distances are great; California and Maine are far apart. The airplane and the telephone have brought them into adjacent neighborhoods, but Congressmen and film stars are as yet our most frequent transcontinental travelers. Industrially, *B* is still a tight little island from which she controls an empire. Liverpool is only 200 miles from London, Birmingham 112 miles, Leeds 225 miles, Manchester 184 miles, Glasgow 401 miles. Geographically, all of *B's* great industry is contained in a territory about the size of *A's* New England; so instead of thinking in terms of fourteen Ordnance procurement districts, *B* could reduce the number to two—and one of these would be superfluous!

Again, *A's* mind is a young mind as nations' minds go. It is argumentative and not easily made up. And when made up it does not always stay so. It strives for the counsel of perfection to a nicety, it specifies to the fifth decimal and sometimes to the sixth, and frequently rejects the product eventually to adopt the M2A3T4 model as slightly better, although totally different, from the M2A3T3. *B* is less meticulous and much slower to change. *B's* is an older mind, slower to act, satisfied because that's "the way it's always done," determined to follow through once the decision is made.

FINALLY, there are differences that seem more superficial but which essentially are more basic. *A* has an Army and Navy (and an air organization in both); their jobs are clear-cut, they stand on an equal footing, generally speaking. *A's* First Line of Defense is more welcome at the national pocketbook at one time—the Army at another time. But their lineage is the same. With *B* it is otherwise. *B* has the Royal Navy, the Army and the Royal Air Force. Note that it is not the *Royal* Army. The Army, since the days of Cromwell, has been Parliament's own. The *Royal* Navy and the *Royal* Air Force are of the Crown. *B's* first love is the Navy. Not one of *B's* citizens has to travel much more than a hundred miles from his home to go down to the sea in ships, and he has gone down to the sea in ships from time immemorial. He loves the sea. Upon the freedom of the object of that love depends his very life. *B* seldom has more than three weeks' supply of food on hand.

As a final criterion, sum up all these differences in the respective constitutional forms of government of the two countries. *A's* was adopted at Philadelphia a century and a half ago; *it is a written constitution. B's* was adopted more than seven centuries ago at Runnymede, and to this day *it is unwritten.*

Mind you, I like the *A* way better for *A*, and I do not cite the differences for comparison's sake. I cite them to show why England's industrial mobilization cannot be placed line for line against our system. Industrial mobilization, in England, like the English Constitution, does not exist line for line. Yet industrial mobilization in England is now a going concern and it is going great guns, figuratively and literally.

COMING back to organization, it must be remembered that England, like most of the Continental powers, has a separate air force. Her three branches, equal in responsibilty in their respective fields, are the Royal Navy, governed and operated by the Admiralty; the Army, governed and operated by the War Office; and the Royal Air Force, governed and operated by the Air Ministry. These three are coördinated directly under the Prime Minister by the Committee of Imperial Defense of which the premier is chairman and the ministers of the respective defense services are members, together with the heads of the Treasury, Foreign Affairs, the Home Office and the Board of Trade, the Chiefs of Staff, the principal supply officers of the fighting services, and others, as occasion requires, including representatives of the Dominions. This all-powerful committee brings into closest coöperation the managers of national policy and the heads of the services which apply that policy as conditions require. Moreover, each of the defense services has, in addition to the minister at its head, a permanent undersecretary—a career man of long service who is not subject to the comings and goings of changing administrations and who thus assures continuity of experienced control.

Until last year, this committee, as organized since the war, had been an advisory body to deal with the basis of Imperial defense organization. But the demands of the new defense program made necessary a modification of its structure: (1) partly to relieve the Prime Minister amid growing demands and (2) to coördinate industrial mobilization and allied problems of defense at sea, on land, and in the air, under a minister who would devote his entire time and energy to that one objective.

Thus in March of last year, a Minister for the Coördination of Defense was appointed. He is the deputy chairman of the Committee of Imperial Defense. He is also deputy chairman of the Defense Policy and Requirements Committee. The Minister of Defense is responsible for the proper consideration of all strategical and tactical questions bearing on "the defense of the realm; *i.e.,* on the surface of the water, under the water, on land and in the air." He is charged with the responsibility for providing and regulating an adequate supply of personnel to the three fighting services. Upon him falls the task of assuring the proper equipment and maintenance of all arms of the three fighting services "in a state of readiness and efficiency according to the principles of strategy and tactics adopted."

In addition to these duties, the following specific responsibilities have been delegated to the Minister of Defense:

"(1) The general day-to-day supervision and control on the Prime Minister's behalf of the whole organization and activity of the Committee of Imperial Defense; the coördination of executive action and of monthly progress reports to the Cabinet, or any committee appointed by them, on the execution of the reconditioning plans; discernment of any points which either have not been taken up or are being pursued too slowly, and (in consultation with the Prime Minister or other ministers or committees as required) of appropriate measures for their rectification;

"(2) In the Prime Minister's absence, taking the chair at the Committee of Imperial Defense and the Defense Policy and Requirements Committee;

"(3) Personal consultation with the Chiefs of Staff together, including the right to convene under his chairmanship the Chiefs of Staff Committee whenever he or they think desirable;

"(4) The chairmanship of the Principal Supply Officers' Committee.

"It will be the duty of the deputy chairman to make such recommendations as he thinks necessary for improving the organization of the Committee of Imperial Defense."

THIS then is the emergency governmental modification established to meet present defense requirements. It aims to serve two broad purposes; namely "to provide an improved and strengthened apparatus for the consideration of defense problems as a whole and to insure the fullest and most effective use of industrial capacity and the man power available for production of material in the country." Looking for a comparison with our own organization in the United States, it is as if our Army and Navy, the air forces of both, and our (proposed for war time but nonexistent in peace time) War Resources Administration were placed under a special vice-president who would be given *carte blanche* to get the preparedness job done for all the organizations combined. And Treasury control is maintained through new methods of procedure which look to effectiveness of financial safeguards without impairing continuity of progress. It is not necessary to conclude that once again the old axiom is being asserted: *time* is of the essence.

It would be futile here, because unnecessary, to trace the modifications of this new coördinated system through the three defense services. But it is necessary to single out the main changes which have resulted for the Army.

In September 1936 a new department was organized in the War Office for the specific purpose of developing national resources for the supply of munitions. This is the Department of the Director General of Munitions Production. It is divided into five main divisions. They are:

1. The Central (or administrative) Office. This is the executive office of the director who is responsible for the supply of munitions to the Army from the Royal Ordnance Factories and from the private manufacturers of armament and for plans for such supply in peace and in war. The responsibility for design and quanitative requirements of munitions needed and their inspection before they are passed into service remains with the Master General of the Ordnance who makes known the military needs to the Director General of Munitions Production. (At present there are less than twenty officials and employees in this division.)

2. The Directorate of Army Contracts. This division (which is responsible to the Financial Secretary of the War Office for contracts for general stores and supplies other than munitions) is charged with the duty of obtaining bids and placing or negotiating contracts for all munitions supplies, equipment, and necessary plant facilities, the review of local contracts, and the allocation of orders between the Royal Ordnance Factories and private industry. (There are about 150 officials and employees in this division of whom slightly more than half are engaged on contracts relating specifically to the Directorate of Munitions Production.)

3. The Ordnance Factories Directorate. The director deals with the administration, control and maintenance of the Royal Ordnance Factories. (There are about twelve officials and employees in this division.)

4. The Industrial Planning Directorate. The director is responsible for advice in connection with the adequacy of sources of supply of munitions and for the preparation of plans for organizing that supply for war-time mobilization. Also his function is to advise relating to the adequacy and responsibility of private firms, their plants and personnel for the production of munitions in time of peace. He likewise directs the work of the Munitions Technical Planning Establishment—an organization for the use of the War Office, Admiralty, and Air Ministry—which deals with technical questions arising from the arrangements to augment industrial capacity for the production of munitions. He is also in charge of production engineering. (There are 5 officials and employees in the Industrial Planning Directorate; 139 in the Munitions Technical Planning Establishment.)

5. The Progress Directorate. The Director of Progress is the production manager on all munitions contracts. His office is to watch and report upon progress. His representatives (called the Area Progress Staff) are stationed in the principal industrial areas. He checks designs of matériel from the production point of view and brings to the attention of the officials concerned any suggestions for alteration of designs arising from production problems. (There are less than thirty officials and employees in the Progress Directorate; in the Area Progress Staff there are nine.)

SO MUCH for the newly organized munitions-production agencies under the War Office. They are marked by simplicity, compactness, directness. They seem to overlap in certain points and to oversimplify in others. They do. Straight-line organization would appear more satisfactory from the American viewpoint and probably more economical of effort for the American temperament in the long run. But the personnel expansion in the organization relatively has not been great and the job is being done. Both considerations should be proof enough of adequacy.

There remains for fuller treatment an analysis of the policies this type of organization is pursuing. This we shall take up in succeeding articles, beginning with that much-publicized question of "war" profits of private industry. There are profit controls in England's procedure, but they are not the rule-of-thumb kind. Private industry in England has put its shoulder to the wheel just as private industry in the United States did when last we mobilized. Content to take its place hand in hand with Government, private industry is doing its share, and Government is meeting it halfway. (*To be continued.*)

Propaganda and War

The New Technique of Mendacity as a Psychological Weapon

By Maj. Gen. J. F. C. Fuller*

"GUNPOWDER and printing belong together." These words of Oswald Spengler strike the keynote of the age in which we live: an age of words and wars; an age in which truth is crushed out of political relationships by gigantic lies. That this is so there can be no doubt; therefore it is strange, almost mysterious, why so little interest is taken in what is called "propaganda"—the art of mass lying in order to induce mass neurosis. Possibly the reason for this is, as Lord Bryce once said: "The newspaper press has become so effective an agency in helping politicians to get on and to stay in, that politics has in democracies become a branch of the science and art of advertisement" ("Modern Democracies").

Nevertheless, as propaganda today forms an essential element in warfare, it may be of some interest to both the soldier and the civilian if briefly I outline its history before I inquire into its recent developments. For the war which so many think soon will be, is actually with us now, rumbling, like an earthquake, under our very feet.

That the spoken word is the most primitive of all weapons requires no emphasis because, as such, a word differs only from a material weapon in that it accomplishes its object—the imposition of one will upon another—morally instead of physically. In the British Museum over 20,000 propaganda tracts are to be found dating from 1600 to 1660. Their influence, however, was almost entirely restricted to the literate classes, for as Spengler in his mystical way writes: "The printed book is an emblem of temporal, the press of spatial, infinity" and in England the first newspaper, the *Oxford Gazette* [1] (the original of the *London Gazette*) did not appear until 1665.

The influence of the newspaper was, as Spengler says, "spatial." Daily, like a microbe, did it propagate its views in the intellects of its readers. Crude and limited though the eighteenth-century press was, it went far to precipitate both the American and the French Revolutions. It became the organ of the people, and like a drug it poisoned their lives. During the first of these conflicts, propaganda took upon itself its modern form. James Truslow Adams has noted this in his "New England in the Republic, 1776-1850": "It has sometimes been said that propaganda was a discovery of the last war, but a careful study—which has not yet been made—of propaganda in the Revolution would result in matching all the efforts made between 1914 and 1918."

In the uprising in France it was the same. Spengler, who is always illuminating though not always exact in his generalizations, says: ". . . . the French Revolution in the beginning . . . . witnessed the first tempest of pamphlets of the autumn of 1788 and the first mass fire of artillery at Valmy. But with this the printed word, produced in vast quantity and distributed over enormous areas, became an uncanny weapon in the hands of him who knew how to use it. In France it was still in 1788 a matter of expressing private convictions, but England was already past that, and deliberately seeking to produce impressions on the reader. The war of articles, flysheets, spurious memoirs, that was waged from London on French soil against Napoleon is the first great example." Napoleon soon retaliated, until "to lie like a bulletin" became a proverbial saying. On June 1, 1805, he wrote to Fouché: "It is advisable that the tone of the newspapers be supervised to the end that they attack England in regard to her manners, her customs, her literature and her constitution."

IN the American Civil War it was the same. That conflict was preceded by paroxysms of antislavery frenzy, was inundated by impossible stories, and during it a somewhat amateurish propaganda was carried on by both sides in neutral lands. Simultaneously, Bismarck in Prussia was creating his "reptile press," by suborning newspapers not supposed to be connected with the Government in order to propagate his views. From now on the press becomes the people, and public opinion is replaced by public hysteria. This is seen in the Spanish-American War, and in the Anglo-Boer War in which Alfred Harmsworth made his name. Little wonder that Henri de Blowitz, toward the end of his life grew despondent. "No wonder that he mourned the degradation of his chosen profession, and prophesied that unless somehow veracity could be brought back to the newspapers a 'universal ruin' would encompass Europe." [2]

Though from 1789 to the end of the following century propaganda grew to be the most powerful of political weapons, it is strange that few if any soldiers of note appreciated this. And what was the result? When, in 1914, war was declared, no side being prepared to hold back the corrosive word for the clean-cutting sword, the winning of it, instead of creating a better state of peace than the one broken, left the belligerents not only physically shattered but morally poisoned.

Had only the psychology of war been grasped; had politician and soldier fathomed its depths, surely both would have seen, as General Sherman once saw, that the "legitimate object of war is a more perfect peace," and that unless this objective is gained, war can only result in a political abortion. Because they failed to realize this, the physical contest in

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1. Some writers say the *English Mercuric* of 1588. The *Gazette de France* first appeared in 1631. The Romans had the *Acta Diurna*, and Juvenal speaks of a Roman lady passing her morning in reading the paper.

2. James Duane Squires: "British Propaganda at Home and in the United States from 1914 to 1917."

1914-1918 became but the stalking-horse for a foul moral onslaught, a conflict which, like a noxious gas, poisoned the combatants. Everywhere the word sought victory, and when the sword was sheathed the word corrupted the world.

For the word there were, in the World War, three distinct "battlefields": the home front, the enemy front and the neutral front. These I will examine briefly. As regards the first, so far as soldiers and civilians were concerned, the war opened as a fairly clean struggle. The belligerent peoples were behind their respective governments, and had the war been brought to a speedy end, morally little harm would have been done. But as it dragged on their morale began to subside and "blood transfusions," in the form of propaganda, were resorted to. These were considered necessary not only to vivify the people, but in order to counteract the subversive propaganda of the internationalists. Though it was not generally known at the time, the war will of France was undermined as much through the machinations of the *Bonnet Rouge,* edited by a man called Almereyda who was in German pay, as through lack of military success.

As regards the second "battlefield"—the enemy front—newspapers and leaflets were sent across the lines by airplanes, grenades, and balloons, and though they had little influence on soldiers, as the war lengthened out they undoubtedly helped in undermining civil morale. On all sides an iniquitous campaign was opened with the aim of blackening one another's army and nation. An outstanding example is the Bryce Report, which was translated into thirty languages and published five days after the Lusitania was sunk.

The attack on the neutral front was probably the most damaging of all, because it deprived the war of an impartial referee. Switzerland was its center and every legation and embassy grew into an organ of propaganda. In short, whichever side could win over the neutral world could morally outcast its enemy. Though it is not possible to ascertain what these activities cost, their expenses do not appear to have been excessive. Mr. Squires, in his book already quoted, calculates that during 1917-1918, the cost of British propaganda was about $10,000,000 and of United States propaganda some $5,000,000—truly insignificant figures when it is considered that shells alone cost Great Britain $3,750,000,000.

By the time the war ended, propaganda in all its forms had so saturated the minds of the peoples and their governments that in the demented hysterical world it had created, it was totally impossible to establish a moral peace. Morality had been so outraged that the world had lost all control over its emotions, and a vertitable crusade of destruction was launched against the defeated Powers. In this state of public dementia it was impossible either to create a new world or mend the old: all was fear, vengeance, and confusion. Therefore it was anarchy and not peace which followed the war.

From this highly condensed account of the development of propaganda I will now examine its influence on democracy and autocracy as political systems.

If Lord Bryce is right in stating that it is the newspapers which have rendered democracy possible, and if, as I have shown, the press is a powerful instrument of war, it is impossible to understand the age in which we live unless the relationships between press, democracy, and war are examined.

First, wherein does the power of the press lie? It lies in the freedom of expression. According to Lord Bryce the freedom of the press is indispensable to the proper working of popular government. "So much so," he writes, "that it has figured in nearly all the written constitutions of modern free states. The faith in popular government rested upon the old dictum: 'Let the people have the truth and freedom to discuss it, and all will go well.'. . . A free press—so it was assumed—may be relied on to supply true facts because false facts will soon be discovered and discredited."

Though this idea was never more than relatively true, there can be little doubt that in a simple agricultural civilization and in an age in which the masses of the people were illiterate, the freedom of the press was a great instrument of progress: the few could read and it was the few who ruled. But once general education was introduced and the present machine civilization emerged, the credulity of the masses was at once exploited, and easily so, on account of the complexities arising. So it came about that with advancing capitalism the press became a profit-making concern. Further still, by monopolizing the public opinion it created, it gained such a power over the will of the people that it could make and unmake their governments.

As Lord Bryce says, this power was in fact mystical. "Scarcely any of those who read what the paper tells them know who has written what they read, or what sources of information he possesses, or what intellectual weight. The voice seems to issue from a sort of superman, and has an hypnotic power of compelling assent. . . . Men who would give little credence to a tale told them by a neighbor, or even written to them by a friend, believe what the newspaper tells them merely because they see it in print." To such an extent does public credulity encourage sensationalism and journalistic extravagance that ex-Kaiser Wilhelm II was not far wrong when he said: ". . . . in ninety-nine cases out of a hundred, what is vulgarly called 'public opinion' is a mere forgery."

As the press grows freer, more and more are the masses intellectually enslaved, and the less politically free do they become. As Lord Bryce writes: "On the printed page truth has no better chance than falsehood, except with those who read widely and have the capacity of discernment. A party organ, suppressing some facts, misrepresenting others, is the worst of all guides, because it can by incessantly reiterating untruth produce a greater impression than any man or body of men, save only ecclesiastics clothed with a spiritual authority, could produce before printing was invented. A modern voter so guided by his party newspapers is no better off than his grandfather who eighty years ago voted at the bidding of his landlord or his employer. . . ."

I have quoted Lord Bryce because, as he was a fervent democrat, his views carry considerable weight. Now I will turn to another writer—Oswald Spengler—whose philosophy has so greatly influenced the growth of authoritarianism. Strange as it may seem, his views are almost identical:

"The scattered sheets of the Age of Enlightenment transformed themselves into 'the press'—a term of most significant anonymity. . . . Today we live so cowed under the bombardment of this intellectual artillery that hardly anyone can attain to the inward detachment that is required for a clear view of the monstrous drama. The will to power,

operating under a pure democratic disguise, has finished off its masterpiece so well that the object's sense of freedom is actually flattered by the most thoroughgoing enslavement that has ever existed. The liberal bourgeois mind is *proud* of the abolition of censorship, the last restraint, while the dictator of the press . . . . keeps the slave gang of his readers under the whip of his leading articles, telegrams, and pictures. . . . No tamer has his animals more under his power. Unleash the people as reader-mass and it will storm through the streets and hurl itself upon the target indicated, terrifying and breaking windows; a hint to the press staff and it will become quiet and go home.

"The press today is an army with carefully organized arms and branches, with journalists as officers, and readers as soldiers. But here, as in every army, the soldier obeys blindly, and war aims and operation plans change without his knowledge. The reader neither knows, nor is allowed to know, the purposes for which he is used, nor even the rôle he is to play. A more appalling caricature of freedom of thought cannot be imagined. Formerly a man did not dare to think freely. Now he dares, but cannot; his will to think is only a willingness to think to order, and this is what he feels is *his* liberty. . . . And the other side of this belated freedom: It is permitted to everyone to say what he pleases, *but* the press is free to take notice of what he says or not. It can condemn any 'truth' to death simply by not undertaking its communication to the world—the terrible censorship of silence, which is all the more potent in that the masses of newspaper readers are absolutely unaware that it exists. . . .

"The dictature of party leaders supports itself upon that of the press. The competitors strive by means of money to detach readers—nay, peoples—*en masse* from the hostile allegiance and to bring them under their own mind training. And all that they learn in this mind training, is what it is considered that they should know: a higher will puts together the picture of their world for them. There is no need now, as there was for Baroque princes, to impose military-service liability on the subject—one whips their souls with articles, telegrams, and pictures . . . . until they *clamor* for weapons and force their leaders into a conflict to which they *willed* to be forced. . . . This is the end of democracy. . . . Through money, democracy becomes its own destroyer, after money has destroyed intellect."

I am of opinion the impartial reader will agree that in the main the views of these two men, Bryce and Spengler, upon the power of the press are, if not identical, so closely related as to render their differences insignificant. The one has said (in his "Studies in History and Jurisprudence"): "Almost everywhere [the press] tends to embitter racial animosities and make more difficult the preservation of international peace." The other states: "Now the press campaign appears as the prolongation—or the preparation—of war by other means."

Therefore we are left with war as the ultimate product of the word. Yet, politically, there is a profound difference between these two men, because Bryce, believing in democracy, cannot abandon the idea of the freedom of the press, whilst Spengler, considering that democracy has destroyed itself, plunges into autocracy. Yet, so far as war is concerned, the difference is not radical, because far from abolishing or restricting the power of the press, the dictatorships have monopolized it. The sole change is one of masters—government taking over command from the press lords.

IF the above statements are correct, that is to say, if democracies cannot exist without a free press, and autocracies without its control by the State, and if the press embitters racial animosities and prepares war by other means, we are faced by two certainties: 1. The peace of today is surrounded by a highly explosive emotional atmosphere. 2. In the next war, the war of the word will be waged as it never has been waged before. In short, the next world conflict will at base be far more a psychological than a physical contest, in which souls rather than bodies will be wounded and destroyed. Should this be accepted, if only as a probability, the question arises: Which system of propaganda, the democratic or the autocratic, is likely to prove the more effective?

As regards the first, I need not enter into detail, because I have already traced its development and examined its constitution. There is little doubt that in the next war it will follow in an accentuated way the methods it employed in the last. Then, as radio communication was in its infancy, its main implement was the printed word; but in another war it will be the broadcast. Its radius of action thus will be vastly extended, for millions of people will be appealed to simultaneously making its psychological effect instantaneous. In its way, broadcasting is the moral counterpart of lethal gas, for just as gas can strike an unseen and even unknown physical target, so can the broadcast word strike an unseen and even unknown moral target—the radius of its action being to all intents and purposes infinite.

It is upon this tremendous power of instantaneous stimulation of mass emotionalism that the autocratic system of propaganda is built. But, when compared to the democratic, it stands on far firmer ground, because whilst in the democratic system the masses are electrified by an oligarchy of press lords, each with its own ax to grind, in the autocratic the voice is single and all-commanding. The difference is that between a mob appealed to by a number of antagonistic demagogues, and a drilled body of men under the control of a single leader. Whilst the democratic system is unmethodical, the autocratic is scientific, possessing a carefully thought-out strategy and tactics of its own.

THE idea underlying this science of moral, in contradistinction to physical, warfare is as follows: As physical action springs from an act of will, conscious or unconscious, and as the will is strongly influenced by the emotions, if command over the emotions of the masses can be gained, their wills can be depressed or stimulated and through this their physical actions directed. It is the method of the medieval magician extended from individual to mass action, from the conjuring forth of spirits to the calling forth of mass emotions.

As this is so, it follows that the organization of propaganda represents the power house of mass emotionalism. It can collect it, concentrate it, amplify it, and direct it by the mere lowering or raising of a switch. Though in Germany and Italy this power house is daily in active operation, the "juice" transmitted is almost entirely expended upon fortifying, stimulating, and unifying the people toward national ends—the consolidation of the nation in peace and war. Though these ends are actively sought in the U.S.S.R., ever since the initiation of the Soviet system, propaganda also has been directed outwardly toward morally corrupting the nations so that the world revolution may gain control. As from the

moral point of view this process is an act of war, much more can be learned from the Russian system of propaganda than from that of any other autocratic nation. What then is the Soviet technique?

It is based on two main factors: the unlimited credulity of the masses and the restricted self-assurance of the normal individual. This is clearly explained by Herr Hitler in "Mein Kampf" when he says: "The credibility of a falsehood depends on its enormity. The masses, the crowds in simplicity of soul, fall victims much less easily to the petty falsehood, such as they themselves are guilty of on occasions, than to the great lie which covers them with shame. They cannot believe that others could possibly be guilty of such cynical and deliberate untruth." In other words, whilst lies which normal individuals are capable of telling leave the masses cold, lies they are incapable of telling instantaneously turn them white hot. Therefore the old technique of exaggeration and suppression is replaced by the new technique of colossal mendacity—the more outrageous the lie the more readily is it gulped down. This technique lends itself to a further refinement, for under the cloak of mass emotionalism it enables the most atrocious deeds to be carried out and instantaneously foisted upon the moral shoulders of the enemy.

THE clearest example of how the Russian system is set in motion is the Spanish civil war. Here propaganda may be divided into two periods, the preparatory and the destructive: the mine has to be laid before its explosives are detonated.

Immediately after the establishment of the Republic in April 1931, the Soviet agents got to work. In June 1932, *The Times,* a cautious paper, reported that "evidence continues to accumulate that the Spanish Republic is being made the victim of a vast conspiracy against law and order . . . . in the background there is reason to believe the existence of clandestine and powerful forces." A little over six months later, Andres Nin, a Catalan and at one time a chief lieutenant of Trotsky in Moscow, in an interview informed the Barcelona correspondent of this paper: "We began first with an educational campaign, and now we are engaged in organizing Workers' Soviets in anticipation of the crucial moment when the Workers must be the first to arrive on the scene and to seize power. . . . We undertook to group the masses 'round the symbols of democracy—such symbols as they could understand—and to give the masses illusions. . . . We organized political juntas, which in Spain have a traditional significance, and which at the right moment could be converted into Soviets."

Whilst this was being done, the left-wing intellectuals rotted the middle classes. Witty, shallow, cynical, and without belief in anything outside their cleverness, their chromium-plated brilliance attracted many. Like bacilli, they poisoned the nation and by degrees corrupted it intellectually and so rendered government all but impossible.

As the people began to disintegrate politically, out of decay emerged the "Frente Popular." "The formation of a broad People's Front," declared Dimitrov, the Soviet emissary, "providing for joint action with social-democratic parties is a necessity. Cannot we endeavor to unite the Communist, Social-Democratic, Catholic and other workers? Comrades, you will remember the ancient tale of the capture of Troy. Troy was inaccessible to the armies attacking her, thanks to her impregnable walls. And the attacking army was unable to achieve victory until, with the aid of the famous Trojan Horse, it managed to penetrate to the very heart of the enemy's camp." What was the object of this "horse"? Dimitrov explains it as follows: "Fifteen years ago Lenin called on us to focus all our attention on 'searching out forms of *transition or approach* to the proletarian revolution.' It may be that, in a number of countries, the *United Front Government* will prove to be one of the most important transitional forms."

The countries in question are obviously the democratic, which, possessing so-called free presses and little national discipline can be attacked readily by those nations in which the press is under government control and the people are disciplined and completely isolated from foreign, and unceasingly stimulated by national propaganda. From this it will be seen that in the autocratic countries wars can be prepared for by both internal and external propaganda, as is being done today by the U.S.S.R. Further, should war break out, psychologically the autocratic countries will be well prepared, whilst the democratic nations will be open to violent attack.

TO return to the Spanish war. Once moral chaos was established, physical chaos in the form of church burnings and assassinations followed, and directly General Franco raised his standard of revolt against anarchy, the Russian-trained Communists, in order to gain control, at once established a terror and simulantaneously broadcast to the outer world that the atrocities *they had committed* were perpetrated by Franco. This enabled them to go on with their butcheries and turn world public opinion against their opponents. So far the most-noted example of this is the alleged bombing of the town of Guernica, which sent France, England, and the United States into hysterics. Whether this town was bombed or not, is outside the question, because it was in every way a legitimate air target. But what is undoubted is that it was not destroyed by air bombardment, but instead burned down by order of the Basque Government, which, as it set it on fire, attributed its total destruction to Franco's inhumanity. From the point of view of the new propaganda of mendacity this was an extremely skillful piece of work, for it all but outlawed Franco in the eyes of the world.

What is to be noted is that this form of attack will be made use of in the next European war. It will first and foremostly be a war of paralyzing lies. Every hideous deed perpetrated by one side will be attributed to the other side, as well as colossal crimes possible and impossible to carry out. In such a conflict, as Georg Brandes has said, war will mean "the assassination of truth." Psychologically, such a fog of lies will be created that the belligerents will be thrown into a high state of frenzy, making the establishment of a true peace impossible. In such a war the science of lying is likely to triumph.

FROM so satanic a picture it is somewhat of an anticlimax to descend to such a comparatively minute question as that of the relationship between the soldier and the press. Yet it is an important one and one seldom examined. Although hundreds of books have been published on the conduct of war, I do not remember one covering this subject.

In examining this question, it must be realized first of all that in peace time the soldier is forbidden by regulations to have anything to do with the press. Because of this he is frequently, and often most unjustly, criticized so that he has

the highest contempt for journalists. To a certain extent I shared these views until I became a military correspondent during the Italo-Abyssinian War. Then, when I found myself at Asmara one of over sixty foreign journalists, I soon realized that all they wanted was news—good, indifferent, or bad—from which to concoct their stories. News means seeing and hearing, and once it is obtained the second need of the journalist is rapid transmission.

As my problem here is: "How should the soldier make use of the press?" I will turn to the military situation as it faced Italy in October 1935. The Italians were fighting two campaigns, one against the Abyssinians and the other against hostile foreign opinion; therefore their problem was a twofold one—to beat the former and to win over the latter. As regards this second object, the only possible way of gaining it was to win over the foreign correspondents, which meant treating them with consideration, supplying them with news or the means of obtaining it, the establishment of an understanding censorship, and lastly rapid transmission.

Whilst General de Bono was in command, though transport and transmission were bad, because censorship was friendly, and because correspondents, who bought their own automobiles and trucks at fabulous prices, were allowed free movement to the front and back, to my knowledge a number of distinctly hostile papers were won over. (It is almost impossible for the journalist not to respond to considerate treatment.)

But when Marshal Badoglio assumed command, not understanding the importance of the press, he not only interned the correspondents in Asmara, but also so tightened up the censorship that journalist after journalist left—in two months their numbers falling from over sixty to six. Thoroughly disgruntled, these men left and in the safety of their own countries launched a violent campaign against Italy. Though from a purely military point of view this had little effect, because the war was won so rapidly, from a political one it was disastrous, and today it is still detrimentally influencing Italian international relations.

MY next experience was in the Spanish civil war on the Nationalists' side. Here again I found that two wars were being fought, one against the Red Government and the other against hostile world opinion. In the second of these wars the advantages were overwhelmingly on the Red side, for not only had the Valencia Government at its disposal the Russian machinery of propaganda, but, unlike its opponents, it could freely transmit its news through France.

Faced by these two handicaps, what ought Franco to have done? Realizing, as he should have, that news, however mendacious, cannot be obliterated from the public mind by overlate statements of the truth, he should have speeded up his cable transmission through Vigo to the utmost, and set out full-heartedly to win over the foreign journalists. What did he do, or rather what did his press bureau do? First it looked upon all foreign journalists as potential enemies; secondly, it established so meticulous a censorship that delays in transmission were literally manufactured, and thirdly, when journalists showed any hostility to the treatment meted out to them, they were peremptorily expelled from the country. Such folly only can be explained by the gross ignorance of the soldier in the supreme value of the press in war.

Though I have not space here to elaborate the technique the soldier ought to adopt, it should be remembered, as I have said, that the object of every journalist is to collect news, dramatize it, and get it to his editor as quickly as he can. Should he get it in first, he, so to say, "scoops" the news, and up goes his prestige and possibly also his salary. Therefore every journalist is interested in "scoops" and the easiest way to win them is to plan "scoops" for them and speed up transmission to its maximum.

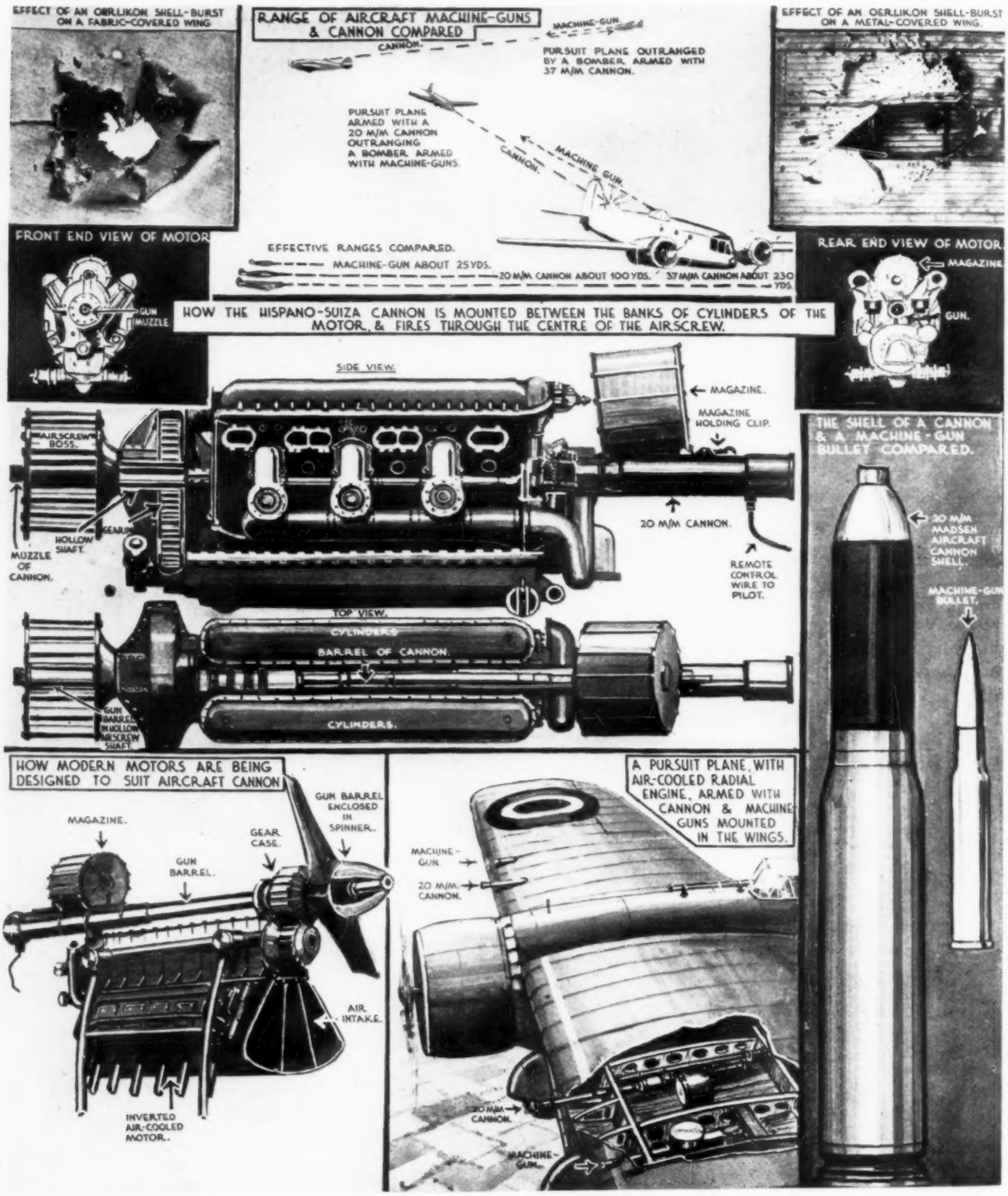
Again the military importance of a journalist depends not only on the prestige of his paper or agency, but on the potential number of his readers; therefore all journalists should not be treated as equals. For instance, when in Salamanca, I met a noted American correspondent who commanded 40,000,000 readers. He was an elderly man and in most countries has been treated like an ambassador. I found him in the Grand Hotel completely lost and thoroughly disgruntled. Now, had I been head of Franco's press bureau, I should have welcomed him as a prince, and attached to him a bright young officer to act as his A.D.C. to look after his personal comfort, to be at his beck and call, to take him about, show him everything and a little more than most journalists. I should, unknown to him, have arranged for his cables to be given precedence over all other American cables—and what would have been the result? He would have "scooped" the American press, and by letting him do so, of a certainty I should have "scooped" him and through him the majority of his readers.

GLANCING over what I now have written, not only will it be seen that as Disraeli said "people are ruled by words," but that in war time words become potent weapons. In fact, in the mass-emotional age in which we live they are essential instruments of war. Whilst it is generally recognized that on account of air power the civil nerves can be directly attacked in war, in democratic countries it goes unrecognized that propaganda is an even more potent means of attack on the civil will in peace time as well as in war.

How this is to be prevented without a complete change in the moral structure of our civilization, I cannot say. Therefore we must accept the considered opinion of two such different men as Bryce and Spengler that the press, free or controlled, will continue to be a generator of wars, and that the next war will be more a psychological than a physical contest. Therefore—speaking now solely for my own people—if we, as we apparently must, insist upon maintaining a free press, we shall risk defeat, because if they should wish it, the autocratic nations can, through their subversive propaganda, undermine our morale during peace time. Today the majority of our so-called intellectual writers are left-wing; that is to say they are instruments, red or pink, of Soviet propaganda. In Spain, before the opening of the rebellion in July 1936, we saw the same thing.

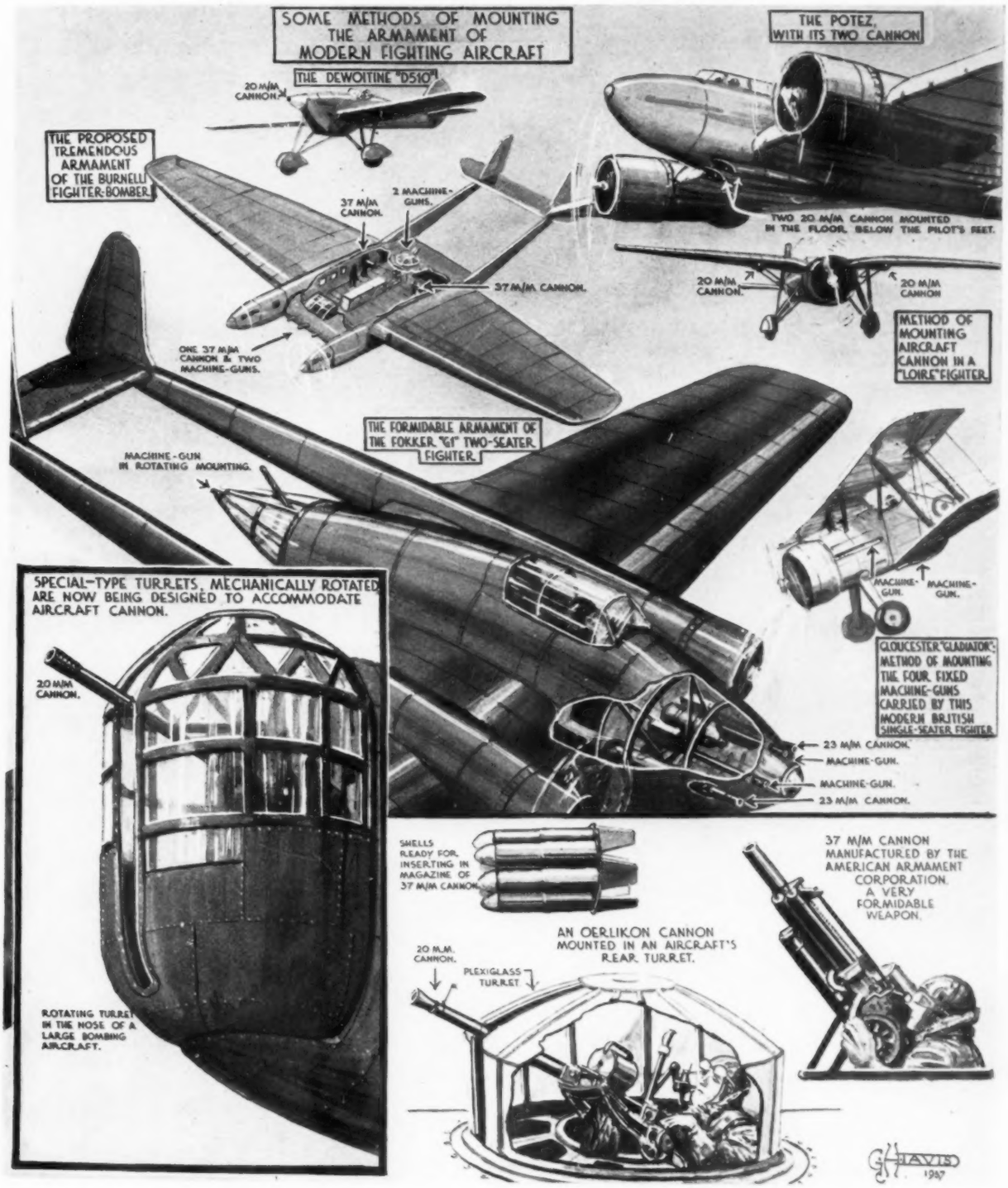
Therefore it seems to me that granting the maintenance of a free press, our Government should do two things: 1. Stir itself to its utmost to counteract all foreign propaganda in this country. 2. Create an organ which will closely examine and study the methods of propaganda of foreign countries, and which, when war is declared, will instantaneously take over control of our press. The whole of the foreign technique should be analyzed, more especially that of the U.S.S.R., not in order to create an equally mendacious system, because in my own opinion truth can be more effective, but that we may be in a position in the next war to protect ourselves against the barrage of lies that will come.

Artillery Mounted in Aircraft


EFFECT OF AN OERLIKON SHELL-BURST ON A FABRIC-COVERED WING
RANGE OF AIRCRAFT MACHINE-GUNS & CANNON COMPARED
MACHINE-GUN
CANNON
PURSUIT PLANE OUTRANGED BY A BOMBER ARMED WITH 37 M/M CANNON.
PURSUIT PLANE ARMED WITH A 20 M/M CANNON OUTRANGING A BOMBER ARMED WITH MACHINE-GUNS.
MACHINE GUN
CANNON
EFFECT OF AN OERLIKON SHELL-BURST ON A METAL-COVERED WING.
FRONT END VIEW OF MOTOR
GUN MUZZLE
EFFECTIVE RANGES COMPARED.
MACHINE-GUN ABOUT 25 YDS.
20 M/M CANNON ABOUT 100 YDS.
37 M/M CANNON ABOUT 230 YDS.
REAR END VIEW OF MOTOR
MAGAZINE
GUN.
HOW THE HISPANO-SUIZA CANNON IS MOUNTED BETWEEN THE BANKS OF CYLINDERS OF THE MOTOR, & FIRES THROUGH THE CENTRE OF THE AIRSCREW.
SIDE VIEW.
MAGAZINE.
MAGAZINE HOLDING CLIP.
AIRSCREW BOSS.
HOLLOW SHAFT.
GEARING.
MUZZLE OF CANNON.
20 M/M CANNON.
REMOTE CONTROL WIRE TO PILOT.
TOP VIEW.
CYLINDERS.
BARREL OF CANNON.
CYLINDERS.
GUN BARREL IN HOLLOW AIRSCREW SHAFT.
THE SHELL OF A CANNON & A MACHINE-GUN BULLET COMPARED.
20 M/M MADSEN AIRCRAFT CANNON SHELL.
MACHINE-GUN BULLET.
HOW MODERN MOTORS ARE BEING DESIGNED TO SUIT AIRCRAFT CANNON
MAGAZINE.
GEAR CASE.
GUN BARREL.
GUN BARREL ENCLOSED IN SPINNER.
AIR INTAKE.
INVERTED AIR-COOLED MOTOR.
A PURSUIT PLANE, WITH AIR-COOLED RADIAL ENGINE, ARMED WITH CANNON & MACHINE GUNS MOUNTED IN THE WINGS.
MACHINE-GUN.
20 M/M. CANNON.
20 M/M CANNON.
MACHINE-GUN.

IN 1917, bombing airplanes proved easy prey for pursuit aircraft which were about fifty per cent faster. Today, bombers can fly over 250 miles an hour, while single-seater fighters can fly only a little more than 300 miles an hour. Hence, to make their fighting craft more effective, European nations are arming them with quick-firing cannon of 20-, 23-, 25-, and 37-mm. caliber. Firing high-explosive shells with supersensitive fuzes, these guns not only have more destructive power than the machine gun, but their effective accurate range is much greater. The 20-mm. cannon—the most commonly used—has an effective range up to 100 yards, and the 37-mm. weapon up to 230 yards. Machine guns used in aërial combat have effective accurate ranges much less than these. However, the single-seater fighter, due to its size, usually is restricted to but one small-bore cannon which makes it

New Weapons for Aërial Warfare


SOME METHODS OF MOUNTING THE ARMAMENT OF MODERN FIGHTING AIRCRAFT
THE DEWOITINE "D510"
20 M/M CANNON.
THE PROPOSED TREMENDOUS ARMAMENT OF THE BURNELLI FIGHTER-BOMBER.
37 M/M CANNON.
2 MACHINE-GUNS.
37 M/M CANNON.
ONE 37 M/M CANNON & TWO MACHINE-GUNS.
THE FORMIDABLE ARMAMENT OF THE FOKKER "G1" TWO-SEATER FIGHTER.
MACHINE-GUN IN ROTATING MOUNTING.
THE POTEZ, WITH ITS TWO CANNON
TWO 20 M/M CANNON MOUNTED IN THE FLOOR, BELOW THE PILOT'S FEET.
20 M/M CANNON.
20 M/M CANNON
METHOD OF MOUNTING AIRCRAFT CANNON IN A "LOIRE" FIGHTER.
MACHINE-GUN.
MACHINE-GUN.
GLOUCESTER "GLADIATOR": METHOD OF MOUNTING THE FOUR FIXED MACHINE-GUNS CARRIED BY THIS MODERN BRITISH SINGLE-SEATER FIGHTER.
23 M/M CANNON.
MACHINE-GUN.
MACHINE-GUN.
23 M/M CANNON.
SPECIAL-TYPE TURRETS, MECHANICALLY ROTATED, ARE NOW BEING DESIGNED TO ACCOMMODATE AIRCRAFT CANNON.
20 M/M CANNON.
ROTATING TURRET IN THE NOSE OF A LARGE BOMBING AIRCRAFT.
SHELLS READY FOR INSERTING IN MAGAZINE OF 37 M/M CANNON.
37 M/M CANNON MANUFACTURED BY THE AMERICAN ARMAMENT CORPORATION. A VERY FORMIDABLE WEAPON.
AN OERLIKON CANNON MOUNTED IN AN AIRCRAFT'S REAR TURRET.
20 M.M. CANNON.
PLEXIGLASS TURRET
G. H. DAVIS 1937

no match for the tremendous fire power of the modern bomber. This situation has given rise to a new type of aircraft—the multigun fighter such as the Fokker G1 which has a speed of over 250 miles an hour and mounts two 23-mm. cannon and two machine guns forward and one machine gun in a protected rotating turret aft. It can carry two hundred 23-mm. shells for the cannon and 1700 rounds for the machine guns. The Loire Fighter carries two 20-mm. cannon mounted in the wing. To meet these new threats, bombers are being armed with 37-mm. cannon which outrange the smaller guns. This trend is developing the "fighting bomber" such as the proposed Burnelli mounting three 37-mm. cannon as well as four machine guns. (The drawings on this and the preceding page are reproduced in this issue of ARMY ORDNANCE *by courtesy of The Illustrated London News.)*

War-Time Contracts

Tentative Plans for Prompt Production and Fair Prices

By C. C. Fenn*

THERE are several prime considerations relative to war-time contracts: first, the economic and industrial problems attendant upon war-time procurement; secondly, the permanent statutory limitations of the contractual powers of Government agents; thirdly, the probable temporary legislation which may be expected; and fourthly, the extensive use by the Government, in war time, of the right of eminent domain. Developments since the World War have brought forth another prime consideration—the elimination of unreasonable war-time profits.

The problem of war-time contracts is in reality one of developing the tools of efficient governmental business procedure under war conditions. The task is to avoid the contractual pitfalls of the World War, and to fit into present procurement planning the necessary contractual relationships to industrial production. In contrast to the war contracts of 1917 and 1918, this phase of planning has advanced considerably. Uniform contractual forms for War Department current procurement have been adopted for the use of all supply arms and services. The use of these same fixed-price forms with necessary emergency clauses will avoid a sudden change to meet war conditions. Likewise, the forms for informal contracts and purchase orders in use at present also will be available.

THIS is the fifth in a series of articles on procurement planning by chiefs of the various divisions of the Planning Branch, Office of the Assistant Secretary of War. It presents an analysis of the several proposed forms of contract for the purchase of materials required by the Army of the United States in time of war.

While seeking to exert a reasonable control of profit where necessary, these plans do not anticipate any unfair advantage either on the part of the Government or of the contractor. Their aim is to meet war-time military requirements for matériel with as much dispatch as possible and, at the same time, eliminate the uncertainties of contractual procedure with attendant waste of time, material, and money.

Previous articles in this series were: "The Army and Navy Munitions Board," by Col. H. W. T. Eglin (March-April issue, p. 275); "Standards for Army Supplies," by Capt. George V. McPike (May-June, p. 344); "Procurement Planning," by Lieut. Col. G. M. Barnes (July-August, p. 21) and "The Allocation System," by Maj. Scott B. Ritchie (September-October, p. 77). Other articles in the series will follow.—EDITOR.

Without criticizing the general contracting procedure during the World War which had, as a whole, gratifying results, a few of the principal difficulties in carrying out World War contracts are significant. There was the voluminous task of interpreting the various forms used severally by the different supply arms and services, of which there were approximately 400. And, in addition, there were three major obstacles. First, there were the legal and financial difficulties encountered in fixed-price contracts where no allowance was made in the contracts for future variations in the price the contractor was forced to pay for materials and labor; secondly, the legal difficulties which resulted from having no termination clause in war contracts; and lastly, the unauthorized signing of contracts on the part of the Government by appointed deputies who signed the name of the contracting officer indicated in the body of the contract and then signed their own names thereafter. Contracts signed in this manner were generally called "proxy-signed contracts."

Strange as it may seem, of the 27,000 War Department contracts in existence on November 12, 1918, 7500 had not been executed in the prescribed manner. A test case was taken to the Supreme Court of the United States (*N. Y. & Porto Rico S. S. Co.* vs. *U. S.*, 239 U. S. 80) and the court held that such a contract could not be enforced by the contractor against the United States. The Secretary of War, therefore, could not pay out anything under it except for goods had and received or for services rendered to and accepted by the United States. This however would not do justice, for in almost every contract, there were goods in process, overhead expenses, and other items which would not be covered or reimbursed merely by taking over the finished product at the contract price. The Secretary of War could not amend these contracts as he could in the case of agreements properly signed, for it is a fundamental principle of law that an amendment is itself a new contract, and that no contract may be made without a consideration; that is, in order to make a valid amendment, something of value must pass to the United States. Now, as the informal contract was not enforceable against the United States, no amendment to the contract was legally possible.

It became obvious that if justice was to be done, remedial action by Congress was required. Some months later the so-called Dent Act was passed. Under this act the contractor was obliged to file his claim with the War Department, and Boards of Contract Adjustment came into being which found themselves flooded with work. During all this time the contractor was put to additional expense in presenting his claim, was deprived of his money, and in most instances interest thereon, through little or no fault of his own. His patriotism went to a low ebb. And Army "red tape" got the blame.

THE present adopted war-contract forms have been the subject of much study by the Office of the Assistant Secretary of War and by the War Contract Board—a permanent board within the War Department consisting of officers of the Assistant Secretary's Office and of the various supply arms

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and services. Five contract forms have been approved tentatively by the Assistant Secretary of War and will be discussed briefly. They are: (1) Contract for Supplies (Fixed-Price); (2) Contract for Construction (Fixed-Price); (3) Evaluated Fee Construction Contract; (4) Evaluated Fee Construction Subcontract; and (5) Adjusted Compensation Contract.

The war-procurement forms now adopted do not carry the name of the contracting officer in the body of the contract. The term used in the preamble covering this part of the agreement reads that the Government is "represented by the contracting officer executing this contract." This designation is legally sufficient and will avoid the difficulties encountered with the so-called proxy-signed World War contracts. Termination clauses are now included.

The fixed-price supply and construction contracts now contain a flexible price clause relating to material and labor. There is no doubt that the inclusion of such a provision will encourage formal and informal competition and contract negotiation for a fixed price, for if the contractor is assured he will be compensated for radical price rises, he will feel more justified in making a set-price offer. The approved provision of the present contract reads:

"Article XI—Changes in Prices of Labor or Material: If a Federal agency appointed for the purpose of controlling the price of labor and/or material causes or approves an increase or decrease in the price which the contractor is paying for the labor and/or the material for use in the performance of this contract, the contracting officer shall promptly determine the increase or decrease in the cost to the contractor of performing this contract that will result from such change and this contract shall, with the approval of the head of the department, be modified accordingly."

In passing, it may be said that the word "controlling" used in this article has now been found objectionable. In the first place, it is a word we generally seek to avoid in procurement planning. Secondly, flexibility is one of our war-procurement administrative mottoes. Thirdly, the War Department never has advocated—in fact has avoided any assertion promoting—the control of the price of labor, and it is probable that if such control were imposed it would be in the final stages of mobilization. Price control of material may or may not be adopted. It is now proposed that the word "adjusting" be substituted for the word "controlling." The provision then might be applied to an agency within the War Department itself, in the War Resources Administration or elsewhere. This provision would then become a feasible one for war developments.

THE fixed-price forms for the purchase of supplies and construction are to be used where procurement may be based on competition or negotiation. In other words, where peace-time procurement has laid a basis for war-time expansion and a satisfactory determination of a fair price can be had, then the fixed-price forms may be used. It will be remembered in connection with war procurement, that the peace-time compulsion of formal competitive bidding set out in Revised Statutes 3709 is not a directive to war-time contract procedure, but may be a short cut in the direction of the Secretary of War. The greatest advantage of the fixed-price contract is that it is the customary method of doing business. Other forms may seem sound theoretically but they do not always work out as well as they might in practice.

In the event a construction project is not subject to a fixed-price contract, then the use of what has been approved as the Evaluated Fee Construction Contract is contemplated. Expansion of existing chemical plants and air-plant factories, and the building of plants and additions thereto necessary in ordnance-matériel production probably will come within this category.

The evaluated-fee construction contracts are, in general, modeled after the construction contracts used during the latter part of the World War and found to be generally satisfactory. The principal change from the old form is the inclusion of a variable fee between certain percentage limitations, the adjustment to be based upon efficiency in performance by the contractor; *viz.,* speed of performance, quality of manufacture and economy of performance. The Evaluated Fee Construction Subcontract extends the principles of Evaluated Fee Contract to all subcontractors.

Although War Department policy is to use the fixed-price contract as far as practicable, it is certain there will be some situations where a contractor will not be in a position to bid a fixed price or one that is satisfactory to the Government. The article may be an extremely intricate invention that never has been manufactured in quantity. Complete conversion of plants may be required; for example, if an automobile manufacturer were to manufacture airplanes. These are situations where contractors might be more anxious to protect themselves against loss than to make large profits. They may expect that the Government will take most of their profits through excess-profits taxes in any event, and for that reason might prefer some sort of a cost-plus contract. For these and similar situations there has been developed the Adjusted Compensation Contract.

This contract, in brief, proposes to reimburse the contractor for the cost of the work and pay a profit which is based primarily on the property investment, that is, the value of the buildings, machinery and facilities utilized under the contract. Additional profit may be gained by a saving between the estimated and actual costs of production, the actual payment to be, in general, twenty-five per cent of the difference involved. In addition, the contractor receives six per cent on his working capital.

THE adjusted-compensation form represents a great amount of thought and consideration by various experts. Its principal fault lies in the fact that the form is to be used for the manufacture of articles about which there is little information as to cost of production while the first agreement necessary under the contract is an estimate of the cost of labor and material and overhead necessary to secure this same production. The contractor obviously is going to get these figures as high as he can for his own protection, and as already has been noted, a part of his net fee is based on the difference between the estimated and actual costs. Thus it will be seen that the problem of adjusting a war-time contract to meet this particular situation is heavily involved. A straight cost-plus contract never could be defended since our World War experience with this form. Contracts based upon estimated cost of production have the objectionable features heretofore discussed.

The Legal Section is now attempting to draw a supply contract to bridge the field between the fixed-price contract and the adjusted-compensation contract. Representatives of the Treasury Department, the Internal Revenue Bureau, and

various civilian agencies have been consulted in reference to its promulgation. The objective has been to draw a contract as simple as possible under the circumstances, to avoid the necessity of basing the price on an estimated cost of production, and to divide the profit into elements which may be controlled to fit a particular contractual situation.

The preliminary draft of a contract promoting this objective has been drawn. By the preamble it will be noted that the contract is placed as a compulsory order under Section 120 of the National Defense Act. The primary purpose of this action is to give the contract legal preference over existing civilian contracts which the contractor may have, and legally to relieve the contractor from the responsibilities of complying therewith.

Article I contains a statement of the work—what is to be made, how it is to be made, and the when and where of delivery. Article II sets out the elements of consideration. Article III provides for reimbursement to the contractor for all direct labor and materials and proper proportion of overhead, exclusive of depreciation and/or amortization. Article IV provides for a payment of a monthly rental of the plant or part thereof to be used for Government manufacture. Under the provisions, the contractor shall proceed immediately with the performance of the work; the rental feature is made as a supplemental agreement to be consummated within two months from the date of the principal contract.

IN connection with this rental feature of the contract, civilian advice and assistance have been sought. It will be appreciated that similar questions are arising daily in the business world. Large fire-insurance companies now are writing an insurance contract known as a "use and occupancy policy," which provides for a payment to an industrial organization for time lost by the closing of a factory for various reasons. The rental to be paid under a Government contract such as here discussed should be based, it seems, upon what is commercially known as the *sound value* of the plant; *viz.*, the cost of replacement, new, as of the date of the appraisal, less a reasonable depreciation however caused. All fire-insurance companies today are basing the amount of coverage permitted under a policy on this determined value of a factory. When fire losses occur, the payment is made on the same basis. In this instance, the physical characteristics of the property may be gone but adjustments are made regardless. In recent years, many industrial plants have been refinanced—all requiring the same appraisal as is called for under this section of the contract. The problem of an equitable rental based upon sound value will not be an entirely new and foreign consideration in time of war.

Reputable national organizations now are actively accomplishing such appraisals for large fire-insurance companies, investment companies, and private individuals and companies. From research made to date, it seems fair to assume that in time of war such facilities could be used to advantage by the Government, or individual experts could be called into the Government service and form a division in the contract sections of the supply arms and services or at the procurement districts concerned with such contracts (principally the Ordnance and Air Corps). All appraisals could be made by these units. The procedure followed by the large appraisal companies today probably would be found satisfactory. Field men of the organization make the physical inventory of the plant; experts on real estate make their report on the buildings and grounds; the experts on different classes of machinery and equipment make their individual reports. The actual appraisal is done at the group headquarters and is based on these several reports. These figures then could be coördinated with the estimates submitted by the contractor.

In this connection, it is of interest to learn that the civilian services mentioned place a time limit of two weeks for the appropriate appraisal of some of our largest airplane and automobile plants. It will be recalled that a time limit of two months has been specified in the proposed contract form. In case of disagreement the contract outlines the procedure to be followed.

ANOTHER basis of investment determination is suggested by the Valuation Division of the Bureau of Internal Revenue. That is, to pay the contractor a rental based upon the cost, less depreciation already taken for tax purposes. In 1934, the Treasury Department, through the Commissioner of Internal Revenue, issued a directive on cost data to be filed with the Bureau which was recapitulated on July 10, 1936. I quote in part from this directive: ". . . . taxpayers claiming deductions from gross income for depreciation must furnish full and complete information regarding (1) the cost or other basis of assets for which depreciation is claimed; (2) the age, condition and remaining useful life of the assets; (3) the portion of the cost or other basis which has been recovered through depreciation allowances for prior taxable years; and (4) such other information as may be required to establish the correctness of the deduction claimed or to determine the amount of the deduction properly allowable." As a result of this order, every industrial plant of any size will have on file in the Internal Revenue Bureau their own statement as to the cost valuation of their factory and these statements are kept up to date during each taxable year.

The cost inventories are filed by groups: real estate, heavy machines, moveable tools, etc. The depreciation schedules are inserted. Costs of machinery discarded or scrapped are shown in red. The burden of proof is on the company to make a correct compilation, and taxes are paid accordingly. Reports of large companies are divided into plants and various facilities. The United States Steel Corporation recently filed its schedule which is composed of many volumes. The cost of this compilation was estimated to be at least $400,000. If, in the contract under discussion, these figures were used as a basis of rental and the records of the Internal Revenue Bureau were complete and up to date, the problem of compiling Exhibit A of the contract would be comparatively simple. These Internal Revenue schedules are all confidential at this time, but in time of war I presume they could be made available for contractual purposes. Whether the sound value or original cost be used as a basis of rental, these records will be of material assistance in arriving at the objective of a fair monthly rental. A percentage of 4.8 would appear to be a fair return to the contractor on his investment. Whatever basis of valuation may be used, depreciation must be distributed on a monthly basis and added to the rate allowed on the property valuation.

A very important point, recently ascertained from the Bureau of Internal Revenue in connection with contractual allowances for depreciation, is that regardless of what allowances may be made in such contract, the income-tax laws require that the payment involved be included in the gross income; the actual deductions to be permitted are determined

ARMORED CARS—INTRICATE ITEMS OF WAR-TIME MANUFACTURE *Acme*

by the Bureau of Internal Revenue and if determined by that Bureau to be less than the amount paid under the contract, the balance is taxed as profit.

HAVING now, by contract, separated compensation for the use of the plant from production operation, the inspiration—in addition to patriotic incentive—toward the efficient operation of the plant and the promotion of efficient production by the owner is provided for in Article V. By this provision a graduated fee is paid the contractor, in addition to his rental, based upon a percentage of the actual cost of the work performed—all of these direct costs being paid by the Government. The contractor then is assuming no risk in connection with his manufacture, which is a reasonable provision under the attendant circumstances of production. This payment is then, in a commercial sense, compensation for management and is based on a maximum and minimum sliding scale dependent upon speed in performance, quality of work performed, and low cost consistent with speed and quality of production rendered to the Government. As the total cost of work (exclusive of rental) increases, the percentages governing the fee decrease. This same principle of compensation already has been approved in the Evaluated Fee Construction Contract. In other words, the contractor will not be tempted to pile up his costs in order to receive a resultant larger fee.

The planning for war-time contractual procedure is a responsibility of the chiefs of the supply arms and services under the supervision of the Assistant Secretary of War. The procedure contemplated necessarily must be flexible, depending directly on the strength of the mobilization. Furthermore, the procedure, in placing contracts, may vary widely in the procurement of various classifications of material. For example, contractual procedure for the manufacture of certain commercial articles for which the nation's existing productive capacity is adequate may be procured in war time by peace-time competitive methods. This does not mean that in time of war all the formal peace-time procedure will be followed, but the principle of competitive bidding will be possible to the extent of shortening the time for receiving bids, limiting bids to the available producers without disrupting other allocations, and securing these bids by telephone or personal attendance around a conference table at a district headquarters. Bids thus may be awarded to the one, two, or three lowest bidder or bidders, and in this way prices may be subject to considerable control.

Where the purchase of noncommercial items is involved or the whole producing capacity is necessary to comply with requirements, competition will be impossible and contracts must be negotiated as to fixed price, or one of the computed profit forms of contract heretofore mentioned will be the alternative.

WAR-EMERGENCY legislation relating to industrial mobilization received more attention during the last Congress than at any time since the war. On April 12, 1934, a Special Committee on Investigation of the Munitions Industry was authorized by the Senate and directed, among other things, to review the findings the War Policies Commission made in its report of 1932. Pursuant to this resolution, public hearings were held in September and December of 1934 and throughout the first four months of 1935. As a result, our 1933 Industrial Mobilization Plan became a subject of study, comment, and criticism.

It will be remembered that the War Policies Commission recommended in part "in order to eliminate all doubt concerning the extent of the power of the Congress to prevent profiteering and to stabilize prices in time of war, that a proposed constitutional amendment clearly defining such power be submitted by the Congress to the States." Since 1932, further legal study has been made of this subject, and the United States Supreme Court, since that date, has announced certain decisions relating to legislative powers affecting public interest, the leading case being *Nebbia* vs. *New York* (291 U. S. 502), in which the right to regulate the price of milk in an emergency was held not in violation of the due-process clause of the Constitution. It now seems to be recognized generally that in time of a major emergency, price control commensurate with the emergency at hand would be constitutional, and that Congress may enact such legislation as may be considered necessary to place a restriction on profits through taxation and industrial licenses.

Diesel Engines

Their Continuing Development Opens New Fields of Application

By H. S. Eberhard*

ALTHOUGH the Diesel engine is looked upon by many as an innovation, it is not new. On the contrary, following experiments by Dr. Rudolph Diesel and others in the early nineties, the first Diesel-type engine built and used commercially went into service in 1898. Starting then, one United States builder and several in Europe made Diesels—mostly large marine and stationary units for powering pumping plants, ships and electric generators. These engines proved highly satisfactory and some of the earliest units made still are giving successful and satisfactory service.

Early engines had relatively large bores, operated at slow speeds, and were extremely heavy when considered in terms of pounds of weight per horsepower produced. In spite of simplicity of operation, there were many obstacles to be overcome before the high-speed Diesel engine could be widely used and accepted as successful. First was the necessity for a more fundamental knowledege of the problem of combustion control in the engine.

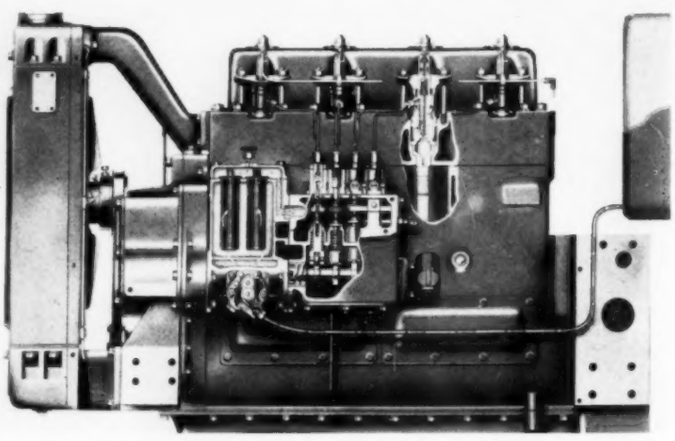

FIG. 1. FUEL-INJECTION SYSTEM OF A HIGH-SPEED DIESEL

Into the design of early engines went much that was the outcome of speculation and preconception of operating conditions. Operation was chiefly a result of "cut-and-try" methods. This state of affairs could, therefore, lead only to the accumulation of very restricted ideas concerning the design of such engines and consequently resulted in a narrow field of application. The high-speed Diesel, as it was then called, was almost entirely without precedent, and consequently a search for more fundamental knowledge of the problems impeding its progress was essential. Higher speeds had to be reached if increased power from smaller, lighter engines was to be made available. This was necessary before there could be a ready acceptance of the Diesel for mobile service such as it now is rendering in high-speed and switching locomotives, tractors, and other commercial vehicles.

There were several basic combustion systems, each of which predetermined variations in engine construction. Added to this were the differences of opinion regarding other details of design related to the engine as well as to the fuel-injection equipment. All of these had a bearing on the successful functioning of the complete unit. In an 800-revolution-per-minute Diesel engine, for example, the total injection period amounts to only six-thousandths of a second; the quantity of fuel injected at full load is extremely small, and injection pressures may be as high as three or four thousand pounds per square inch. Much new equipment, therefore, had to be developed to make possible a study of the involved combustion processes in order to help eliminate the unfit.

Progress was inevitably slow, but the fact that progress was, and still is being made, is reflected in the ever-continuing improvement in engine performance. Only a relatively few years have passed since it was considered impossible to obtain satisfactory combustion in engines operating at speeds of 1000 to 1500 revolutions per minute. Such speeds, however, are no longer thought of as high when considered in the light of present-day automotive requirements, and only a lack of even more complete combustion knowledge prevents a still wider application of the high-speed Diesel engine.

Not only has it been necessary to develop a combustion system which would function satisfactorily in a high-speed engine, but it was essential also that reliable performance be made possible for long periods of time without the necessity of maintenance by skilled operators. Where large engines are installed in marine and stationary service, a trained engineer or operator is on hand to perform any maintenance work necessary to insure uninterrupted operation. A broader acceptance of the Diesel engine as a source of power for mobile equipment could be insured only through improvements in design which made possible the same trouble-free operation we have come to expect from gasoline engines in the hands of unskilled operators the world over. This meant that combustion control had to be maintained by fool-proof injection equipment which could be replaced readily without elaborate adjustment. Each fuel-injection pump and valve had to be exactly like every other similar unit so that installation of one or more new units in an engine would provide unimpaired operation. To attain this ideal necessitated a more complete knowledge of the demands placed upon the injection equipment by the combustion processes. It also required the development of special test equipment over which every production unit would pass in order that there might be made the only adjustments necessary to insure absolute interchangeability in the handling of the minute quantities of fuel. Fig. 1 shows the fuel-injection system of a modern high-speed Diesel engine, tracing the path of the fuel from the tank to

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FIG. 2. GASOLINE TRACTORS AND A DIESEL AT WORK ON A MISSISSIPPI LEVEE

the combustion chamber. The gear-type fuel-transfer pump forces the oil through the filters into the fuel-injection pumps at approximately fifteen pounds pressure. About 750 pounds of pressure are built up in the pumps, forcing the fuel oil through the lines and into the injection valves. This pressure overcomes the pressure of the spring in the valve, lifting it from its seat and allowing the fuel to spray into the pre-combustion chamber where the highly compressed and heated air causes the burning to begin. From there the expanding fuel is forced into the main combustion chamber resulting in the power stroke.

THIS discussion of factors which have retarded the broader adoption of the Diesel principle for mobile use, has so far been focused around the combustion process. The inherent reason for the existence of the Diesel is its ability to show high economy through the consumption of cheap fuels. This economy must not be undermined by additional maintenance costs, and low maintenance presupposes satisfactory combustion conditions. It is apparent, therefore, that without the solution of many of these problems, there would remain for the Diesel only a very limited field of application.

In addition to having developed means for insuring satisfactory combustion control, it was essential that the basic engine structure be improved to the point where the physical size and weight per unit of horsepower could be materially reduced. Progress in this direction has been made possible by the continued development of new materials and manufacturing methods until today the "high-speed" Diesel engine does not compare too unfavorably with the other engines with which it must compete for favor. Materials of lighter weight, increased strength, improved corrosion resistance, etc., all have been made commercially available as a result of tremendous expenditures and a vast amount of research work.

Not only the availability of new materials and improvements in the old, but the development of new methods of treatment and manufacture have helped solve problems which make possible today's high-speed, light-weight Diesel engines. Because of increased cylinder pressures, the Diesel engine naturally demands a basic structure with strength in excess of that required for a gasoline engine of comparable size. Through the use of materials and their treatment not available a few years ago, it now is possible to provide a design capable of accommodating the demands of Diesel service without the burden of excessive weight.

The use of these newer and therefore somewhat more costly materials together with the more generous proportions naturally provided in certain other parts, logically result in an increased cost of manufacture of the Diesel over a gasoline engine of comparable size. The resulting increased price to the consumer is justified, however, by the substantial savings effected in the cost and consumption of fuel. The attractive features of the Diesel engine, as compared to the gasoline engine are, as previously mentioned, its ability to operate on cheaper fuels and its low consumption of these fuels. Fig. 2 shows a Diesel tractor working alongside gasoline tractors on a Mississippi levee. The owners declared that their Diesel units performed beyond the fondest expectations "due to the increase in power, low operating cost, and increased yardage." As the high-speed Diesel continues to find broader acceptance, a rise in the price of Diesel fuels may be expected. The price differential would, therefore, be less favorable to the Diesel, but even a considerable reduction in present operating economies will permit it to more than hold its place.

The degree of economy obtained from the Diesel is dependent primarily on the number of hours the equipment is used, the fuel consumption in gallons per hour, and the cost of fuel per gallon. It is evident, therefore, that the most noticeable economies are afforded those installations where the load factor is high, and where operation is continued throughout all or most of the twenty-four hours of each day. In spite of this, the savings effected from installations subject to a low load factor and infrequent use, are such as to provide economic justification for the Diesel in practically all classes of service.

Although the development of more efficient combustion

systems, new materials, and improved manufacturing methods were largely responsible for today's widespread acceptance of the Diesel in mobile equipment, there remained another factor on which considerable energy had to be expended if the advances made in other directions were not to be greatly, if not wholly nullified—the universal availability of suitable fuels. This does not mean that specially refined fuels, conforming to some very selective set of specifications, are necessary. There are, however, certain specifications—easily provided by any refiner—which are found desirable in order to insure maximum performance characteristics and a minimum of maintenance expense. In the solution of the fuel problem, the manufacturers have had the whole-hearted coöperation of the oil companies who very early expressed a willingness to provide the desired types of fuel, once the demand had become apparent.

CHIEF among the requirements for a satisfactory fuel was cleanliness. To the uninitiate, this may seem a rather trifling problem to overcome, but the progress that has been made to date has been possible only through the expenditure by manufacturer and refiner alike of huge sums to provide satisfactory fuel-handling equipment and for an extensive educational campaign. This campaign served to inform users of the rewards which might be theirs simply through the exercise of care and consideration in the selection and handling of the fuel used in their engines.

All the care that goes into the selection and treatment of materials used in fuel-injection equipment, along with the careful assembly and calibration of complete units, is rendered useless in a relatively few hours' time if contaminated fuels are used. Today, however, satisfactory fuels are procurable throughout the world.

Quite another problem which faced the engineer in bringing about a general acceptance of the mobile Diesel engine was the matter of providing a suitable means for starting. In the large marine and stationary installations the answer was satisfactorily afforded through the use of air for starting. This equipment, however, added to the complication of the Diesel engine itself, and unless properly maintained by experienced operators was quite likely to give troublesome and unsatisfactory performance. Additional space requirements also made such starting equipment undesirable. Electric starting equipment, similar to that used on present-day automobiles, is very limited in its field of application. The equipment necessary to provide successful electric starting of even a small Diesel engine is quite expensive, and where the equipment must be operated at low temperatures, as is often necessary, not only is sufficient battery capacity almost impossible to obtain, but in addition some auxiliary means of warming the engine preparatory to starting must be provided.

Another means of starting—occasionally used—provides a sufficient amount of auxiliary equipment to permit converting the Diesel into a gasoline engine until starting can be accomplished in the conventional manner, after which the switch is made to Diesel operation. This method, however, adds complication to the Diesel engine and necessitates careful maintenance of the gasoline-engine parts in order to prevent interference with satisfactory operation as a Diesel. Careful synchronization of the related gasoline- and Diesel-engine controls also is necessary.

The most acceptable starting means for the current mobile Diesel engine for industrial use has been provided by mounting on the Diesel a small gasoline engine which is connected to the flywheel ring gear by means of a clutch and pinion. Here we have a small engine readily started under any atmospheric temperature conditions and which can in no way affect the operation of the Diesel engine itself. The separate starting engine also provides waste heat which may be utilized to warm the Diesel and prepare it for a proper start.

The foregoing discussion of several factors that have influenced the acceptance of the Diesel as a mobile prime mover should be sufficient to have generated in the mind of an interested individual thoughts which point surely to a continued advancement and consequently to a more universal field of application. Each step along the way has provided a more dependable performance and a closer approach to the desired specifications.

We hear of ever-increasing numbers of Diesel-powered commercial vehicles in operation in this country and abroad, and advances sure to come within a relatively few years will in all probability make this field as predominantly Diesel as are the heavier tractor and industrial divisions at the present time. We daily are witnessing the expanding application of the Diesel in railroad service. High-speed trains already have proved their right to a place in the transportation picture, and the improvements in engine performance that will result from added experience in this service will afford ever-increasing approval. Diesel switching locomotives for freight service are already well established and their number is constantly increasing.

WIDESPREAD acceptance of the Diesel in automobile and aviation service still must await the solution of additional problems which confront the engineer. In aviation service, the reduction of weight is of extreme importance, and, as yet, Diesels have not been built which, in terms of pounds of weight per horsepower, approach that of the best gasoline engines. However, such desirable characteristics as elimination of fire hazard and increased cruising radius are of sufficient importance to presuppose continued development which will provide both performance and specifications acceptable to the aviation industry.

In the automotive field, we already read accounts of Diesels appearing on the streets of Europe where the demand for economy of operation is greater than in the U. S.

In any event, further improvements in combustion control are necessary before the present-type Diesel engines will be entirely suitable for use in automobiles where considerable idling, light load and variable-speed operation are demanded.

Continued improvements in combustion control and other factors having influence in engine performance eventually will permit increasing the power obtainable from engines of a given size. Likewise, still further reductions in fuel consumption will provide economy of operation with a still closer price differential than now exists between gasoline and Diesel fuel.

More and more the concentrated efforts of manufacturers and other interested investigators are making possible a knowledge of the problems involved to the point where an approach to the desired goal is already discernable. The possibilities of the high-speed Diesel engine already have been demonstrated—its future is undoubtedly assured.

American Memorial to the Services of Supply in France

Inscription: "Erected by the United States of America in grateful recognition of the achievements of the Services of Supply, American Expeditionary Forces, 1917-1918."

"Procurement—Construction—Administration—Distribution."

Devices: Coats of arms of the following cities—Tours, Bordeaux, Brest, Neufchâteau, St.-Nazaire, Nevers, LeMans, Is-sur-Tille.

ON August 5, 1937, this beautiful fountain on the banks of the Loire at Tours, France, was dedicated to commemorate the achievements of the 650,000 men who served in the Services of Supply of the American Expeditionary Forces. Their work behind the battle lines made possible the brilliant achievements of the American armies in the field.

The work of the New York architect, Arthur Loomis Harmon, the memorial fountain rises on the Quai d'Orleans at the edge of the Loire, near the stone bridge around which Tours spreads. The crowning feature is a bronze group depicting an American Indian about to release an eagle. On the upper basin are figures representing administration, construction, procurement, and distribution, the four principal subdivisions of the Services of Supply, that great organization established for the care, support, and munitionment of the 2,057,907 American troops who served in France. Tours was the general headquarters of the S.O.S.

Today nothing remains of the gigantic system of warehouses, railroad and artillery repair shops and those factories where uniforms, rifles, and small arms were repaired or made over. The little towns surrounding Tours which hummed with American activity in 1918 are quiet villages again.

But to the memory of the supply achievement of the A.E.F. stands this memorial "erected by the United States of America in grateful recognition of the achievements of the Services of Supply, American Expeditionary Forces—1917-1918."

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Month by Month

MAJ. GEN. WILLIAM H. TSCHAPPAT, Chief of Ordnance, announced recently the appointment of Mr. E. A. Muller to be chief of the Cincinnati Ordnance District. He succeeds the late Col. Charles L. Harrison who organized the district during the World War, conducted its operations at the height of that momentous period and remained as its civilian chief during the eighteen intervening years until his untimely death, December 16, 1936. Mr. Muller had served as the assistant district chief of the Cincinnati area during most of Colonel Harrison's régime.

Mr. E. A. Muller, Cincinnati District Chief

The new chief of the Cincinnati district is preëminently an engineer, manufacturer and executive. He is typical of that kind of leadership which has brought American industry to its present high state of efficiency, manufacturing technique to its undreamed of achievements, and American economy its unchallenged record in the mechanical arts.

A native of Cincinnati, Mr. Muller was educated in its public schools and at the Ohio Mechanics Institute as well as under private tuition. Motivated by an ambition to design and build machinery, he started in business for himself shortly after he had learned the machinist's trade. His entire business life has been devoted to the design and manufacture of many types of machine tools. In 1904 he became vice-president, chief engineer, and general manager of the King Machine Tool Company and now is actively engaged in these capacities with that company. He designed and marketed a new type of vertical turning machine which was further improved a decade ago. The company has confined itself exclusively to the building of this machine, and it has found extended use in the largest plants in this country which use boring machines in their processes of manufacture.

Since 1890 Mr. Muller has been prominently identified with the American Society of Mechanical Engineers, having served as a member of the Society's council, as vice-president, and for a time as a member of its finance committee. He is also a member of the Franklin Institute of Philadelphia. Always active in the affairs of the National Machine Tool Builders' Association, he served that organization as treasurer from 1926 to 1928 and as president from 1933 to 1934.

When the Cincinnati Post of the Army Ordnance Association was formed in 1925, Mr. Muller became its first president and has taken a permanent part in its activities ever since.

The national defense of the United States is fortunate in its choice of Mr. Muller for this important office. Cincinnati is often referred to as the machine-tool capital of the United States, and it is especially fitting that he who holds high place in the machine-tool fraternity should be elevated to the district chiefship. Machine tools are at once a prime concern and a heavy responsibility in any ordnance program in peace or in war, and while there is great manufacturing capacity in the Cincinnati area in addition to its machine-tool facilities, there is wisdom in selecting this most capable machine-tool authority. Moreover, the new district chief is a gentleman of highest intellectual attainments, of sturdy business acumen and of unfailing loyalty to any cause which he espouses. No finer selection could have been made in the choice of a successor to the great Colonel Harrison who pioneered the Cincinnati area as a vital link in the Ordnance program—a status which Mr. Muller by ability and tradition is certain to carry on.

THE very enlightening study of our military air power and our contemplated use of it which the distinguished commander of the Army's GHQ Air Force contributes to this issue of Army Ordnance can be hailed as a definite service to sound thinking on our national defense. Maj. Gen. F. M. Andrews, the author, and other officers of the Army Air Corps and the Navy already have brought to the fore the necessities of military air defense. The analysis as published in these pages should advance the solution of the problem toward an up-to-date effective goal.

Security From the Air

Any observer who follows the trend of military thought of the times must be impressed by the sincerity and quantity of discussion emanating from military authorities throughout the world on the proper use and organization of air power. These discussions embrace views of all degrees. At one extreme some begin with the notion that military air power is simply and purely an auxiliary weapon; at the other extreme some end with the grandiose claim that defense from the air has obliterated entirely and completely every need for the older, time-established arms. Between these two extremes are similar shades of thought varying from those who contend that the fear complex created by bombardment from the air will end a war in an afternoon, to those who say that the same emotions under the same stresses will stiffen morale and prolong the conflict indefinitely. One view may be as good as another when the final rôle of air power is decided; meanwhile it is extremely significant that opinion is crystallizing and progress is on the wing.

Writing in a recent issue of the *United Services Review*, Air Commodore L. E. O. Charleton, whose book of several years ago, "War From the Air," was hailed with considerable

acclaim, recalled some of the basic tenets of air power as proposed by the Italian Gen. Giulio Douhet. General Douhet was among the first to refer to the airplane in a written military order as a weapon, thus placing aircraft on a par with the saber, the bayonet, and the field piece. The main points in the Douhet doctrine were: 1. An air force as powerful as the limits of expenditure would allow, to be absolutely independent of both other arms; 2. This force must be the primary arm of defense; 3. Its rôle would be to act offensively, leaving to the army and navy the strict function of defense; 4. Most of the available money should be spent on the air, leaving only enough for the minimum establishments necessary for army and navy to be secure from defeat at the hands of corresponding forces opposite. General Douhet, like Commodore Charleton and many others, thus places upon the air arm a grant of power which not everyone is prepared to concede to it, but which some contend is one of those coming events which cast their shadows before. Casting the longest shadow is, perhaps, the fact that nineteen nations in Asia and Europe, according to Maj. Gen. William C. Rivers, U. S. Army (Retired), have formed a department of national defense in the last two years. Many of these have independent air forces, coördination of the three functions being delegated to one command.

As we read General Andrews' text we conclude that through the medium of the GHQ Air Force has come a better appraisal of our air power to meet our own problems. His is a satisfying answer for the moment to the one great question: Are we making proper use of this power? But we candidly believe that the airplane as a weapon has even greater potentialities than some of our military and naval authorities of an older school are yet willing to concede, so that the real mission in the air is not yet definitely fixed. It is to be hoped, as we evolve our own solution for the United States, that some very real facts will not be overlooked, and above all will not be hidden by sheer prejudice. The simplest of these is that the military airplane has increased the range of missile-throwing weapons not by miles but by continents, it has increased the speed of military observation and maneuver not by paces but by miles per hour, it has increased fire power not by pounds but by tons. How best to use so potential an element of military power, in conformity with our national needs, is the foremost military question of the day. General Andrews' analysis will serve to promote sound discussion of it.

We need not bother whether our military man power ranks nineteenth among the nations of the world. Nor need we follow suit because some nations, in solving their particular military problems on the basis of geographical propinquity, have found a unification of land, sea, and air forces the best system of defense. Our one concern should be that we have always at hand the best force to meet our own possible needs —best in trained men and effective equipment, ready at the instant of attack to repel and protect. The GHQ Air Force will meet these defense needs provided it is not starved by neglect of its personnel or matériel. It always must be at maximum efficiency. For General Andrews' efforts to that end, for the coöperation of General Tschappat, Chief of Ordnance, and General Shinkle, Chief of Ordnance Field Service, toward better armament and supply, and for the zeal and enthusiasm of Air Corps and Ordnance personnel, the country should not only be grateful but anxious to show that gratitude by constant support—moral and material.

THE men behind the men behind the guns are not always thought of in the stress of battle because theirs is not the glamorous mission of leading a charge. Yet their function is none the less vital to the success of any military campaign. He who reads the annals of military history unaware that supply is of the very essence of victory has missed the basic point of both strategy and tactics. The great Stonewall Jackson summed up the art of war when he said that its objective is "to mystify, mislead, and surprise the enemy." None of these objectives is possible if military supply of one sort or another is absent.

The Memorial at Tours

How strikingly these truths were emphasized by the American effort in the World War! And how appropriately they have been symbolized for all time by the American memorial which was dedicated at Tours, France, on August 5, 1937. To the glory of all those who participated in the Services of Supply, of which the Ordnance responsibility was a gigantic part, this monument symbolizes the services of the men who made possible the heroic success of the American armies in France.

We quote below several paragraphs from the dedicatory address by the Hon. Charles A. Eaton who was one of the official representatives of the United States at the dedication of the Tours memorial:

"Here at the headquarters of the Services of Supply it is fitting that we dedicate today this beautiful memorial in honor of the more than 650,000 members of our American Expeditionary Force, whose labors made possible the heroic achievements of their compatriots at the front.

"These were the soldiers of the second line. They constituted the main artery through which the lifeblood of America's united support flowed to sustain the men in the battle lines. In its magnitude and complexity their task was without parallel in the annals of warfare. They were inspired by brilliant, resourceful, and courageous leadership. It is within the truth to say by the masterly coördination of their fourfold divisions of administration, construction, procurement, and distribution they were able to accomplish the impossible. Across 3000 miles of ocean they transported an incredible mass of supplies sufficient for the war-time needs of more than 2,000,000 men. They built railroads and highways, docks and warehouses. They constructed dams for water supply and intricate systems of electrical communication. They erected factories, and equipped them with modern machinery for fast and efficient production. They carried to the battle lines billions of dollars' worth of ordnance and other fighting equipment. And, to their eternal glory, let it be recorded that nowhere in the accomplishment of their prodigious task is there the slightest stain of dishonor. . . .

"This memorial which we dedicate today stands as a permanent symbol of that will to be free which is alike the hope and glory of France, of America, and of every forward-looking nation in the world. . . ."

It is fitting that this memorial should stand so close to that spot where the headquarters of the Services of Supply were established and operated during the World War. But more significant is the ever-fresh homage of a grateful nation —more lasting than stone or metal—for the men and women of the military service and in industrial life who successfully accomplished the greatest task of supply in all history.

Gas as a Weapon

An Editorial

AFTER more than a year of intense fighting in the civil war in Spain and months of conflict in China, information which, strictly speaking, could be called of a military nature, is decidedly meager. Our publicists grind out colored stories which must be interpreted in the light of a severe censorship. We have heard a great deal about bombing by great numbers of aircraft, and of artillerey bombardment, but there has been nothing in the dispatches which have come to our notice about the use of gas. In itself this is most significant. Amid obviously faked horror stories from Spain why has not some sensationalist come forward with that most "gruesome" weapon—gas—in his effort to sway public opinion by photograph and story?

In all probability gas has not been used in the Spanish war because it did not meet the tactical conditions which governed there. And this, in turn, may be because the conflict is primarily of an offensive nature. Undoubtedly gas could have been supplied by either side as easily as were demolition bombs or artillery projectiles. Refraining from the use of gas was no doubt a decision of generalship, and in this an old rule of generalship—as good as it is rare—applies. When will the casual newspaper reader ever realize that the decisions of good generalship are the controlling factors in the success or failure of a military campaign? It is perfectly apparent that if all the "horror" stories of bombing and bombardment are true, then there was no need to desist from the use of gas. We are compelled to argue that since gas was not used for obvious psychological reasons then neither was there the indiscriminate bombardment and aërial attack on military and civilian personnel with which our press has been saturated for more than a year.

Those who hold that the potentialities of chemical warfare are so great that New York or Chicago could be gassed in a day, must answer the question why Madrid was not annihilated by gas in August 1936, or why the Alcazar survived a siege of more than a hundred days. There is a great deal of debunking yet to appear when the real military story of the Spanish civil war is written, but already there is ample proof furnished by this campaign that gas warfare is simply an adjunct to military operations and by no means the all-powerful agent the historical writers would have us believe. Gas is an agent to be used sparingly if at all—and then mainly in defensive action.

This brings us to public notice of important discussions of gas warfare which have appeared in recent months. We refer to the very remarkable and authentic book by Lieut. Col. Augustin M. Prentiss and Maj. G. J. B. Fisher, "Chemicals in War," and to an article which appeared in the *Saturday Evening Post* by the former chief of the Chemical Warfare Service, Brig. Gen. C. E. Brigham, "How Serious Is This Gas Menace?" One cannot read either or both without being struck by the sanity of the military viewpoint and, by the same token, the assininity of some journalistic minds about this important question. General Brigham is straightforward in his effort to disillusion. It is high time that we had more of this sort of discussion with which to combat the evils of ignorance and fear. Colonel Prentiss and Major Fisher, with the advantages of a book-length treatise, explore the subject in all its ramifications, and no one in the future should express a definite judgment until he has absorbed the historical background, technical status, and military possibilities as recounted by these authors.

It is easy enough to show why these conclusions are inevitable. In the light of experience—and as things go, of very recent experience—the use of gas as an auxiliary in certain types of warfare is to be expected. True, international conventions have been proposed which aim to outlaw gas. But it has not been outlawed. It was used freely in the World War and again in the Italo-Ethiopian War. Its record in these conflicts must not be overlooked.

LET us now consider the World War figures. As nearly as can be determined with any degree of accuracy, 125,000 tons of various gas agents were used in combat between 1915 and 1918. Some of these were extremely effective; others were practically worthless. But this was the experimental era of gas warfare. Of casualties during the World War, gas accounted for approximately 1,300,000. Death among these did not exceed 91,000. From these statistics we may assume that one ton of gas produced ten casualties and that deaths occurred in the ratio of one for each 1.3 tons of gas used. It is a surprising fact that the ratio of deaths to casualties for *all* combatants (in the order of seven per cent) was about three times as large as for the A.E.F. alone.

A number of explanations for this have been advanced. Gas discipline in the A.E.F. was efficient as also was the alertness of the American Medical Service to the gas hazard and the treatment of gas casualties. Then again, dwindling supplies during the latter months of the war may have accounted for the less-intensive use by the Entente. The fact remains that gas accounted for only five per cent of the total casualties of all nations during the World War. And of the 225,000 American casualties in France, 72,500 (or about thirty per cent) were attributed to gas.

These figures are necessarily approximations, but their interest is more than academic. He who is guided by experience as being an index to the future might safely assume that gas warfare in future conflicts will produce not less than twenty-five per cent of battle casualties—and possibly as high as fifty per cent depending on unpredictable factors—and that the fatality rate will probably vary between 2.5 and 7.5 per cent of the total casualties. Bearing in mind that a large number of gas casualties during the World War were returned to duty after hospitalization of short periods and frequently after cursory medical treatment, the record seems to indicate nevertheless that these battle casualties were produced with less expenditure of military effort and ammunition than were required for casualties with other weapons. The point we make is that gas proved to be an effective military weapon and armies are not given to forgetfulness of the instruments which bring victory, provided those instruments meet the accepted requirements of the rules of civilized warfare.

Fifteen years elapsed before the use of gas was again resorted to on a large scale. In the Italo-Ethiopian War a

different stage in the evolution of this branch of military science was demonstrated. Despite the fact that some observers of this conflict have discounted the efficacy of gas, and others, with equal emphasis, attribute the collapse of military resistance to it, whatever the actual fact, gas was effectively used in a campaign of movement. Mustard gas was dispersed by airplane, and from what we have read of this campaign, only mustard gas was used. It was dropped from the air in large bombs filled with multiple containers, and at times was used on a lavish scale. If this campaign proves anything with regard to the use of gas, it shows the disastrous effect on a people who were entirely lacking in protection against gas warfare. Apparently the Ethiopians had no gas masks, they had no degassing agents, they lacked training in how to avoid gas casualties and they had no gas discipline. They were as helpless when confronted with gas as were the Russians during the World War, and they suffered correspondingly.

BUT in a discussion of gas as a weapon, we must quickly come to essential questions upon the answers to which rests the sound approach to the defense problems involved. The first question, more or less psychological, is this: Will the economic, religious, or racial struggles of the future cast all the rules of generalship aside and become mere campaigns of annihilation and frightfulness? The second: Can those who are charged with the defense of a country such as ours discard the patent fact that gas has been used as a weapon in two major wars of the past twenty years and may be used again? Shunning the rôle of a prophet, the following suggestions may be worthy of thought.

No one can say to what lengths a frenzied people may go in their fright, especially when their cause is colored with extremism of one kind or another. Madmen in ages past were known to resort to the flint and by conflagration to annihilate entire cities. But the defense against such use of the flint was to strike down the user and show him no quarter. Who can say what use may be made of other simple destructive media in the days to come? Now, it is grossly unfair and childishly unwise to overstate the case for frightfulness in connection with gas warfare. No finer statement of the case in this regard has ever been made than that of Hoffman Nickerson in his "Can We Limit War?" Discussing "the future of frightfulness," Mr. Nickerson has this to say and to good purpose:

"As to gas, chemists in their franker moments admit the almost insuperable difficulties of using it effectively on any scale. No gas is more deadly or harder to detect than carbon monoxide, and the exhaust fumes from a running automobile engine will render deadly the air of a small closed garage within three minutes, but how many of us are a penny the worse for the tons of this deadly gas released daily in every city by automobiles?

"In February and again in April 1932, Major General Gilchrist, Chief of the U. S. Army Chemical Warfare Service, minced no words in saying that the common bugaboo of whole city populations instantly wiped out in the next war is ridiculous: 'In the first place, a plane would have to fly at an altitude no greater than 400 feet to cause even the slightest damage, and when you consider that many of Manhattan's buildings reach an altitude of a thousand feet and more, you begin to realize the impossibility of danger from gas attacks. I would have no fear at all in going into any second-story room of a building, closing the windows and doors, and without any gas defense at all I would watch through the window while the air currents and breezes wafted the fumes away.' "

The strength of this statement and its truth will be conceded by all people who are ruled by reason; but it is still denied by those who want to be governed by hysteria.

AS to the second question, the obvious answer is that those who are charged with the defense of a country such as ours cannot discard the patent fact that gas has been used as a weapon in two major wars of the past twenty years and may be used again. Therefore prudence suggests that, conforming with all international commitments, we give our best attention to the methods and means of defending our military forces and our civilian population against gas.

Hence we conclude in this day of tension, fanned by absurd propaganda and undermining attack upon basic military philosophy, that gas as a weapon demands a rational defense. Our military authorities must know its characteristics, its counterirritants, its control, and its effects. Upon them rests the obligation to be prepared in this field of military endeavor just as much as it is their duty to house, clothe, feed, and arm a military force. And the obligation goes even farther; their knowledge must be imparted to the civilian component in order that the psychology of frightfulness may be neutralized and protection of civilian noncombatants may be assured.

Secure as we seem to be by geographical remoteness, our problem of protection against gas attack is not nearly as serious as it is in other sections of the world. But that security is not inviolate however its degree may be lessened. Rather there is the stern military obligation that ways and means to defend ourselves against gas as a weapon must be known and understood else we are in the dangerous position of neglecting an agent which fits in perfectly with the technique of mobocracy—a technique which seems to be in the ascendency and which, in all probability, will be counteracted only by the accepted procedure known as military science. In that science, all weapons must be given their due appraisal.

AND beyond this there is a phase of chemical defense which, to the lasting credit of our Chemical Warfare Service, has justified the separate existence of that unit of our Army. The phase is psychological. One has only to read the record of that service to discover that its officers and men, its scientists and technicians as well as the coöperating professional chemists of the country, are the restrained, the factual formers of sound opinion.

Never is theirs the view of the alarmist. Not once will you find theirs the extreme claim. They are not the people who claim civil populations must be attacked—much less annihilated if attacked. Professionally they see in gas an auxiliary weapon of the battlefield to be defended against. Smoke they rightly hold to be the only effective agent to shield offensive machine-gun fire. Gas protection—military and civilian—they claim to be a necessary function.

And over and above all this, they are the real debunkers. The sensationalist thrives on spreading fright, while the realist deals only in fair statement of the potentialities of gas as a weapon. In this our own Chemical Warfare Service—its present and past leaders—merits the highest praise, for never has its doctrine indulged the ghostly, ghastly fancy that gas is all-powerful or that it will be used to annihilate civilization.

Association Affairs

M.I.T. Post, A.O.A.

THE local chapter of the Army Ordnance Association at Massachusetts Institute of Technology was established in January 1922. It has the distinction of being the only student post in the Association and also of being the second oldest of the various local posts which have been established. The initial organization was completed under the able leadership of the late Maj. A. W. Maish, Ord. Dept., who was in charge of the Ordnance Unit, R.O.T.C., at that time.

The Ordnance School for Ordnance officers of the Regular Army then consisted of Course I at M.I.T. and Course II at Watertown Arsenal. When first organized, the membership of the M.I.T. Post consisted of the student officers from Course I and Course II of the Ordnance School, in addition to the M.I.T. students enrolled in the Ordnance R.O.T.C. Unit. Officers consisted of a president and secretary-treasurer, who were M.I.T. students, and two vice-presidents—one from each group of the Ordnance School. In addition, there was an executive committee composed of M.I.T. students.

After a number of years Course II of the Ordnance School was transferred to Aberdeen Proving Ground. The M.I.T. Post then became entirely a student organization, active membership being limited to R.O.T.C. students. However, all Ordnance officers, who are members of the faculty or student body, are entitled to honorary membership.

For the first fifteen years of its existence the chapter was organized on a purely local basis. That is, the local active members were not student members of the national Army Ordnance Association. A nominal membership fee of one dollar was charged to cover operating expenses. However, the Post continued to function throughout this period in a very satisfactory manner. Annual programs were carried out which included guest lectures on ordnance subjects and a number of inspection tours.

During this period it had been customary to select all officers of the Post from the members of the senior class. This policy occasioned a serious lack of continuity, since the new officers each fall found themselves without the guidance of the past executives. To correct this condition and also to bring the Post into closer contact with the national Association, a reorganization was effected in the spring of 1937. A new constitution, drafted by interested students, was adopted and put into effect.

UNDER the new constitution, the Post consists of two classes of active student members: local and national. The local members have the same status as did all student members under the former organization of the Post. The national members consist of those who take out student membership in the parent Association. It was hoped that in this manner the Post would come into closer contact with the ordnance problem, and at the same time would not close its doors to those interested students who might not be able financially to become student members of the national Association.

The tenure of office was changed so that the new officers now assume their duties at the beginning of the spring semester in February of each year. The constitution provides that the newly elected officers must be selected only from the junior class. The new officers therefore have the guidance of the old officers during the spring semester and the activities of the Post may be resumed in the fall with a minimum of difficulty and delay.

The reorganization was undertaken with some misgiving, hence it was gratifying to all concerned to find that a total of thirty-one students had joined the newly organized Post as national members while there were twelve local members.

The new organization has been carrying out the program of the old, and in addition has been able to exert a much wider influence. The Post is a member of the Combined Professional Societies of M.I.T., an organization composed of fourteen junior engineering and scientific societies at this institution. Joint meetings are arranged, and the benefits derived from such broad associations are admitted by all. It was at such a joint meeting of the combined societies in April that the Post was pleased to present Lieut. Col. Burton O. Lewis, Ord. Dept., as guest lecturer on automotive design.

In addition to those on the accompanying photograph, the Post membership also includes Messrs. Anthony, Benson, Castleman, Dana, Fish, Graffeo, Goldberg, Heintz, Hum, L. A. Kiley, K. H. Kiely, Schlansker, Sessler, Stamatos and Torrans. Maj. Harold A. Nisley, Ord. Dept., is in charge of the Ordnance Unit, R.O.T.C., at M.I.T.

Reserve Officers' Meeting, Chicago District

A MEETING of the Reserve officers of all procurement branches was held in Chicago on Wednesday evening, September 8th, under the sponsorship of the Reserve officers of the Chicago Ordnance District. In addition to the Ordnance Reservists, Signal Corps, Engineer, and Chemical Warfare officers also participated, including Lieut. Col. E. H. Lichtenberg, chief of the Chicago Engineer District.

The meeting was addressed by Col. C. T. Harris, Jr., chief of the Planning Branch, Office of the Assistant Secretary of War, who spoke on "Strategic Materials," followed by a discussion of the functions and operations of the Office of the Assistant Secretary of War, with particular attention to the activities of the Planning Branch.

The following day Colonel Harris was entertained at luncheon by Mr. Frederick A. Preston, chief of the Chicago Ordnance District. Others present at the luncheon were Mr. E. A. Russell, president of the Chicago Post of the Army Ordnance Association and chief emeritus of the Chicago District; Mr. George E. Scott, president of American Steel Foundries; Col. Robert P. Lamont, a national director of the A.O.A. and Secretary of Commerce under President Hoover; Col. John A. Holabird, noted Chicago architect, and Mr. E. P. Waud, president of Griffin Wheel Company.

In the evening Colonel Harris was the guest of honor at a dinner-meeting of the Chicago chapter of the American Society for Metals held at the Medinah Club. Speaking on "Minerals in War," Colonel Harris stated that the United States is the most advantageously situated nation in the world from the standpoint of essential war-time minerals and that this country and Great Britain control three-fourths of such minerals. Steel, he said, is the most essential material next to food and clothing. The United States would be most concerned about the sources of manganese, chromium, tin, and tungsten. If outside manganese sources were cut off in war time, Colonel Harris continued, we could supply about twenty-five per cent of our requirements.

Association Membership

ONE of the best incentives to membership in a national organization such as the Army Ordnance Association is the journal published under its auspices. Most technical and scientific societies sponsor publications in which questions of moment in a particular field are discussed, information is disseminated and general *esprit* is cultivated. While Army Ordnance will celebrate its eighteenth birthday next July, its life span thus far

MEMBERS OF M.I.T. POST, ARMY ORDNANCE ASSOCIATION

Front row: Messrs. DeSimone, Cohen, Taylor, Losco. *Second row:* Messrs. Koehrman, Sellers, Kaufman, Matthews, Professor Fuller, Major Nisley, Messrs. Gould, D'Angelo, King. *Third row:* Messrs. Fabens, Gunckel, Phillips, Birch, Austin, O'Brien, Rieser, Pope, Freiberg. *Rear row:* White, Reed, Fife, Neundorfer, Howes, Brewster, Thompson, Mykytow.

is not comparable to that of many publications of older societies. Indeed it is a mere youngster when compared to some of them. Nevertheless, in the opinion of many people, this journal—unique in a highly specialized field—can boast of its contribution to the betterment of our national defense during an important era in our country's history.

Members can take particular pride in whatever positive achievement in its field ARMY ORDNANCE may have brought about. It is their publication sponsored by their own society and financed by their annual dues. It welcomes suggestions at all times as to the nature of discussions in its pages and it strives to be what the Association's membership demands. At the same time it is the best medium for organizational activity. It serves as a bond between all members and the cause they represent. Its message should be as vital and interesting to new members as to old.

MR. ALVAN T. SIMONDS APPOINTED ASSISTANT CHIEF OF BOSTON DISTRICT

AS we go to press we learn of the appointment of Mr. Alvan T. Simonds as Assistant District Chief of the Boston Ordnance District. Col. Charles H. Tenney is Chief of the Boston District. Mr. Simonds is well fitted both by training and experience to assume the duties of his new office. A graduate of Harvard University and a former student at the School of Metallurgy, Sheffield, England, Mr. Simonds has been president of the Simonds Saw & Steel Company since 1913 and president of the Abrasive Company, Philadelphia, since 1927. During part of the war he was a captain in the Ordnance Department at Washington, D. C., in charge of the purchase and production of helmets and body armor. We join with all the friends of ordnance procurement planning in wishing Mr. Simonds the best of success as Assistant Chief of the Boston Ordnance District.

NEW MEMBERS

THE following have been admitted to membership in the Army Ordnance Association: Edward S. Adams, Cleveland, Ohio; L. W. Scott Alter, Cincinnati, Ohio; A. M. Ball, Wilmington, Del.; John D. Billingsley, Metuchen, N. J.; Walter G. Countryman, Rochester, N. Y.; Joseph D'Angelo, Watertown, Mass.; Charles Davis, Cape Cod, Mass. (life member); William W. Dunnell, Jr., Boston, Mass.; Adelbert W. Duskin, Eagleton, Ark.; Kenneth G. Emery, Cleveland, Ohio; N. R. Fletcher, Norwood, Pa.; J. P. Gangwisch, Pittsburgh, Pa.; Gilbert H. Gleason, Winchester, Mass.; T. E. Golden, Columbus, Ga.; Gordon G. Guiberson, Dallas, Tex.; H. L. Harms, Benton Harbor, Mich.; C. Hausser, Waukesha, Wis.; A. A. Herzberg, Waukesha, Wis.; A. H. Hesse, East Alton, Ill.; H. H. Howard, Peoria, Ill.; W. M. Jones, New York, N. Y.; Horace Z. Landon, Newtonville, Mass.; Angus S. Macdonald, Jersey City, N. J.; Maximilian M. MacSweeney, Philadelphia, Pa.; John E. Maher, Jamestown, N. Y.; Bernard Marsden, Chicago, Ill.; Harry D. McKinney, Montclair, N. J.; M. G. Milliken, Wilmington, Del.; Henry E. Moerman, Paterson, N. J.; Roland H. Money, Cincinnati, Ohio; William T. Morris, New York, N. Y.; C. E. Nelson, Jr., Waukesha, Wis.; Robert V. Olson, Attleboro, Mass.; J. R. O'Neil, Spokane, Wash.; David S. Plewes, Effingham, Ill.; Clarke Redfield, Rutherford, N. J.; F. G. Russell, Jr., Jacksonville, Fla.; Albert H. Scheibel, Newtonville, Mass.; Charles R. Spencer, Lynchburg, Va.; Alfred W. Sturr, Owensboro, Ky.; H. M. Tillinghast, New York, N. Y., and Henry Wick, Cleveland, Ohio.

Professional Notes

Resistance of "Bullet-Proof" Glass

By Philip B. Sharpe

AMONG many definitions given by Webster for the word "proof" is: "Firm or successful in resisting; as, *proof* against harm." Assuming this to be the proper definition, "bullet-proof" glass should be capable of resisting the harmful effects of the impact of a bullet against its surface; failing in that, it should be able to protect life and property on the opposite side of the glass from the damaging effects of the bullet, either major or minor. Glass of this nature is invariably listed by the manufacturers and by the Board of Underwriters as *bullet-resisting*.

The writer has been conducting rather extensive tests on various forms of bullet-resisting glass manufactured by the Pittsburgh Plate Glass Company, for protective use in armored cars, pleasure cars engaged in the transportation of important individuals, and in banks around money cages or paymasters' windows and other places where protection against bullets is necessary.

There is a tremendous difference in the effect of the various forms of bullets loaded in our many types of revolver and rifle cartridges in their impact upon the surface of this form of glass. To conduct tests capable of giving a completely accurate picture of the quality of resistance in material of this nature would require several tons of glass and an enormous expenditure of time and money. Accordingly, the tests as conducted were simplified as much as possible.

It is known to technicians that the effect of impact of any form of projectile varies tremendously with the range and the angle of impact. The Springfield rifle with the standard Mark I load, we know, has a greater penetration in a sandbag at 150 to 200 yards than it has at the muzzle. Any object offering major resistance is inclined to have more or less the same effect in varying degrees. In a sandbag, however, or any material of similar nature, the problem of angle of impact is of minor importance as, within reason, penetration will be almost identical regardless of the angle of the source. However on a very hard substance such as glass or steel, the angle of impact is of major importance, as a bullet striking material of this nature does one of three things: penetrates, ricochets, or disintegrates.

On bullet-resisting glass, any form of "angle" shot is inclined to create a ricochet, but tests conducted by the writer show that on all right-angle or "square-on" shots the bullet invariably disintegrates, delivering a shock in the form of a smashing effect on the glass. In some cases this turns out to be penetration, but the major damage is done through the shock released when the surface of the glass plate interrupts the forward progress of the bullet.

Practically any form of projectile will seriously damage bullet-resisting glass, necessitating replacement at the first opportunity. The different types available, however, can offer almost one hundred per cent protection to the individual on the opposite side of the protecting medium.

ARMS used in the tests recently conducted for Army Ordnance consisted of the standard police revolver, caliber .38 Special, with ammunition of the so-called .38/44 metal-point variety, the highest velocity load available in this particular cartridge. The .45 automatic pistol also was used, but in place of the standard load, tests were conducted with the heaviest cartridge available in this caliber as manufactured by the Western Cartridge Company, consisting of a metal-piercing bullet, having a semiconical type of jacket nose with the jacket proper almost double the normal thickness in this nose section. Velocity is more than 100 f.s. greater than the standard load, and while this cartridge is a bit heavy for the automatic pistol, it still can be used successfully for police purposes.

The same cartridge was used in the Thompson submachine gun—five shots being concentrated on a single glass plate 12 inches square. A similar plate was tested with the Thompson submachine gun with five shots of Standard Remington .45 ACP ammunition.

The world's most powerful handgun—the Smith & Wesson .357 Magnum revolver, using a flat-nose lead bullet at a velocity of 1510 f.s. also was tested, since this arm is rapidly coming into favor for police purposes. The tremendous power of this gun was effectively demonstrated by the effect on the glass plate.

In the rifle series, many hundreds of tests could have been conducted if material had been available, but it was necessary to confine this to two calibers—the .30/06 service rifle, using service ammunition of recent manufacture, and that newcomer to the rifle family, the ultrahigh-velocity .220 Swift, driving its tiny 48-grain pellet at a velocity of 4140 f.s.

Bullet-resisting glass, as manufactured by the Pittsburgh Plate Glass Company and approved by the underwriters, is built in layers of varying thicknesses of plate glass bonded together by a sheet of pyralin plastic approximately 1/32 of an inch thick. This glass runs from 1⅛ to 1¼ inches thick in the so-called "Super-Multiplate" and consists of five layers of glass and four layers of plastic. The front or face plate has a thickness of ⅛ of an inch, the second plate about 11/64 of an inch, the third or center plate ½ inch, the fourth plate 11/64, and the fifth or back plate ⅛ of an inch. In the 12- x 12-inch samples tested, this glass averages about fifteen pounds, six ounces per square foot.

The next thickness of glass is known as "Hi-Resist Multiplate," which is approximately 1⅝ inches thick and consists of five layers of glass and four layers of plastic. The first or face plate has a thickness of ¼ inch, the second layer ¼ inch, the third layer 41/64, the fourth layer 1/32 and the fifth or back plate ⅛ of an inch. This material averages twenty pounds per square foot.

The thickest bullet-resisting glass made by the Pittsburgh Plate Glass Company bears their trade-mark, "Hi-Power Multiplate," and averages from 2⅛ to 2¼ inches thick. The sample sent through for tests consisted of four layers of glass and three layers of plastic. Thickness of the face plate was ⅛ of an inch, of the second plate 1 inch, of the third plate ⅞ of an inch and of the back plate ⅛ of an inch. The weight averaged approximately twenty-seven pounds per square foot.

THE first test was conducted with .357 Magnum revolver registration No. 2, barrel length 8¾ inches, ammunition Winchester standard factory load, 158-grain bullet, velocity 1510 f.s. at muzzle. Range tested was in all cases, except for rifle purposes, seventeen feet from muzzle of revolver with impact of bullet at right angles or "square on." A test of this nature is dangerous to the shooter, so protection was offered by placing the 12- x 12-inch samples of glass inside a large wooden packing case against a retainer in the form of a wooden box which served as a support for the rim of the glass. The entire unit was mounted solidly against the masonry wall with the glass resting on its own edge to support the weight at the bottom.

The operator was further protected by shooting at the center of the glass through a hole in a blanket and the face was protected by means of a hat, shatter-proof shooting glasses and a heavy towel wrapped about the lower portion of the face. These preparations were wise, as in many cases flying particles of glass were propelled rearward with sufficient force to create

serious injuries had precautions not been taken. The hand of the shooter was slightly injured in places on the forward exposed portion by these flying particles.

Generally speaking, Super-Multiplate, which varies in thickness from 1⅛ to 1¼ inches, generally is used for window and windshield protection in armored cars, police cruiser cars and for protection of prominent individuals in their armored pleasure cars. This particular glass offers protection in varying degrees when shot with various handguns. It offers no protection against the modern high-power rifle. Against the .357 Magnum cartridge it is totally useless. Tests with this cartridge show the following results (Fig. A):

Major fracture at point of impact, diameter 5 inches. Complete removal of first plastic layer through the face plate, causing a loss of plastic 1 inch by 1¼ inches and forming a crater from which glass left face plate to fly in general direction of shooter. Diameter of this crater 2¾ inches. Penetration of bullet through front plate only. Shock distributed entirely throughout the glass tearing through the back. The bullet completely disintegrated.

General fracture of the thick center plate was greater than the second plate. Complete radiation to edges of glass in radial fractures and to corners and all sides. Upper right corner of the glass only not affected. Radial surface fractures uniformly distributed on top layer and second layer of glass clear to the edge, but not as severely as in the middle section.

On the reverse side (Fig. B) the force of the impact broke through the glass and split the plastic in the form of a Y. This break left a crater of glass completely shattered and pulverized and peeled off from the plastic in the form of a ring. The central portion also was completely shattered in the form of radial fractures which turned the glass white—portion being approximately 2¾ inches in diameter. Width of ring in which entire glass surface is peeled from the plastic by the impact, approximately ¾ of an inch. The glass also was completely shattered in both radial and circumferential fractures over a diameter of 6½ to 7¼ inches. Circumferential fractures are due to the torque exerted by the rapidly rotating bullet, and a consequent transmission of this torque to the glass upon impact sets up unusually severe strains.

The weight of the glass before the shot was fired was fifteen pounds, six ounces; after impact of the bullet, fifteen pounds, one ounce. An additional 1½ ounces of pulverized glass particles were poured from the fracture on the reverse side, reducing the weight to less than fifteen pounds. Of the total amount of glass particles removed, an estimate of glass from the face at the point of impact is probably 1½ ounces. The remaining loss came from the central and back portion through the exit. Enough glass was removed by the impact to stick into the fir-wood surface of a background some eight inches from the glass and would indicate painful superficial wounds to persons as far as six feet behind the glass section. The glass particles were large enough and were propelled with sufficient force to fracture normal spectacles.

A SIMILAR test was made on an additional plate of identical glass which had been exposed to normal sunlight conditions, previous to test, for twenty-seven months. The effect was almost identical (Fig. E), indicating that this modern plastic does not deteriorate.

A few weeks previous to this test the writer conducted a similar one at the Smith & Wesson factory on a light glass of a different make which had seen service in a Post Office Department armored truck with visible signs of deterioration of the plastic in the form of discoloration and minor checks. Here the Magnum bullet ate competely through. Date of manufacture and the amount of service were not indicated by the Post Office Department when submitting the sample.

The sample shown in Fig. F was tested with the automatic pistol and Western Super-X Metal Piercing ammunition at a muzzle velocity of 975 f.s. Thickness of glass, 1¼ inches. The major fracture at point of impact had a diameter of 4½ inches. The original weight of the glass was fifteen pounds, six ounces and no apparent weight loss was noticeable after firing. The bullet completely disintegrated upon impact and left traces of tiny fragments of copper jacket and lead core smeared on the roughened surface of the glass and in the container used to hold the glass plate. The Super-X semiconical pointed bullet had a flat tip roughly 1/16 of an inch in diameter. This tip shows clearly in impact on the glass in the form of a flat topped mound of undamaged glass on the face plate.

The bullet then apparently crept forward on itself as the centrifugal force stirred up therein was disturbed and ate out a slight crater, about 2/3 the depth of the ⅛-inch face plate and approximately 1¼ inches in diameter. A small amount of glass flaked off under the impact; very slight circumferential damage to the face plate and only a few minor radial fractures on the face plate glass extending from this crater to the outside edge. Other minor radial fractures extended but a few inches from the point of impact. The second plate of glass appeared to be slightly more seriously damaged both as to circumferential and radial fractures.

The third or ½-inch center plate received the most damage. Diameter of the major fracture at this point was approximately 4½ inches. Radial as well as circumferential fractures also were more extensive than in either the first or second plate. The fourth plate was quite extensively fractured both circumferentially and radially. The glass appears to be well pulverized within the center and fourth layers; radial fractures extending to the edge of the glass plate are more extensive than on previous layers.

The back or fifth layer was quite extensively shattered although it lost no glass and none appears to be sufficiently loose to injure anyone or create damage by contact of the hand over its surface (Fig. G). This glass would appear to be satisfactory to withstand the effect of the .45 automatic-pistol cartridge in either the standard or Super-X load.

ANOTHER test was conducted with Super-Multiplate having a thickness of 1¼ inches, using the Smith & Wesson 6½-inch-barrel revolver and Remington .38/44 Metal Point ammunition at a velocity of 1125 f.s. There was no loss in weight of the glass after firing. A round flat mound of glass was left in the center portion of the crater formed by the impact, showing a smooth surface and indicating that the center of the glass did not disintegrate upon impact (Fig. H). The major crater formed on the ⅛-inch face plate of the glass was about 1 inch in diameter and halfway into the first layer of plastic. There was no serious damage.

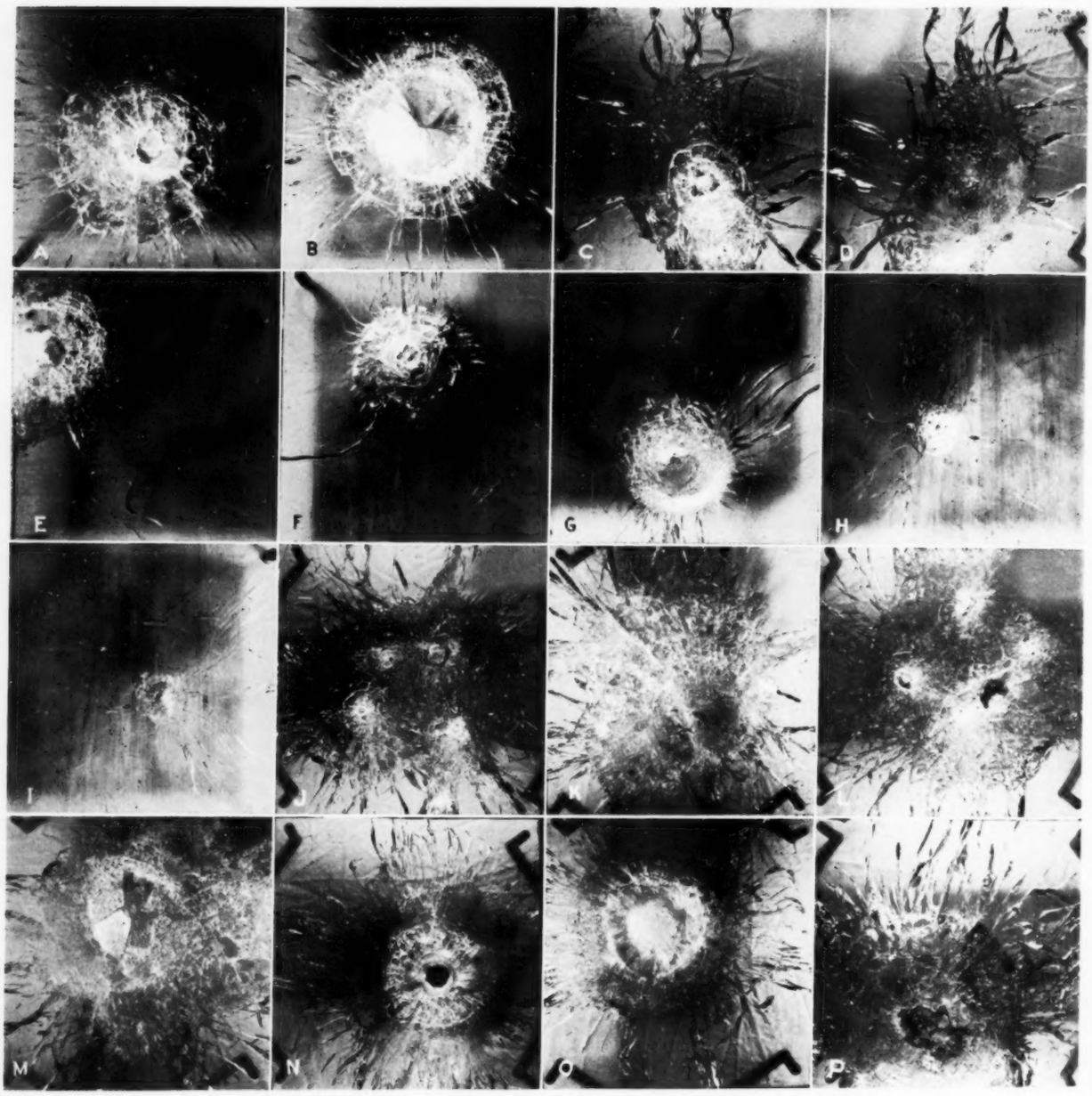
A peculiar condition was noticed in this test. Various circumferential and radial fractures in the first and second plates were visible, but chiefly in the second plate. Diameter of the major fracture in the second plate was approximately 2½ inches and not as serious as with more powerful cartridges. The center plate appears to be undamaged upon examination. Looking through plate from the side, no indication of fracture was noticed.

The fourth plate, separated from the second by a ½-inch center plate, was rather extensively covered with radial fractures but no circumferential, indicating that the shock was in some way transmitted through the thick center plate without damaging that, but in turn shattering the plate on the opposite side. The peculiarity was not noticed in any other form of test firing.

The final or ⅛-inch back plate also was radially shattered, running from the central point almost directly behind the point of impact clear to the edges of the glass (Fig. I). Radial fractures appeared far more serious than on the face plate, but no glass was lost.

A test conducted with the Thompson submachine gun, Model 1928, U. S. Navy, and Western Super-X Metal Piercing cartridge

Tests of "Bullet-Proof" Glass



RESULTS AND DATA OF THE TESTS

Fig. A. Glass 1¼ inches thick; Winchester cartridge, standard factory load, 158-grain bullet; muzzle velocity, 1510 f.s.; Smith & Wesson .357 Magnum revolver, barrel length 8¾ inches; range, 17 feet. Fig. B. Reverse of plate.

Fig. C. Glass 1⅝ inches thick; Smith & Wesson .357 Magnum revolver; range, 17 feet. Fig. D. Reverse of plate.

Fig. E. Glass 1¼ inches thick, weathered for 27 months; same conditions as in Fig. A; shot placed near corner to note shattering effect.

Fig. F. Glass 1¼ inches thick; Western .45 ACP Super-X Metal Piercing ammunition; automatic pistol; range, 17 feet. Fig. G. Reverse of plate.

Fig. H. Glass 1¼ inches thick; Remington .38/44 Metal Point bullet; muzzle velocity, 1125 f.s.; Smith & Wesson revolver, barrel length 6½ inches; range, 17 feet. Fig. I. Reverse of plate.

Fig. J. Standard Remington .45 ACP cartridge, 230-grain metal-jacketed bullet; Thompson submachine gun; range, 17 feet. Fig. K. Reverse of plate.

Fig. L. Western .45 ACP Super-X Metal Piercing ammunition; Thompson submachine gun; range 17 feet. Fig. M. Reverse of plate.

Fig. N. Glass 1⅝ inches thick; Remington 48-grain, soft-point bullet; muzzle velocity, 4135 f.s.; Swift .220 rifle, barrel length 28 inches; range, 25 feet. Fig. O. Reverse of plate.

Fig. P. Glass 2.165 inches thick; standard Frankford Arsenal .30/06 Mark I load, 173-grain boat-tail bullet, full metal jacket; muzzle velocity, 2700 f.s.; Springfield rifle; range, 25 feet.

was then fired with the gun previously warmed up by firing fifty rounds rapid fire to heat up the barrel and thus duplicate service conditions and velocities. Slow-fire shooting was conducted against glass to enable the operator to place his point of impact carefully. This would be impossible with "machine-gun" fire.

The first shot was fired near the center of the plate and duplicated the same cartridge fired in an automatic pistol, although the added barrel length gives an additional 125 f.s. of muzzle velocity. The major fracture appeared to be more extensive. Slow-fire shooting was continued with consecutive shots carefully placed to hold them within the limit of the 12- x 12-inch square, with shots running almost around the rim of a circle and placed 2½ to 3½ inches apart. One shot was placed almost on top of another in an effort to determine effect (Fig. L).

Under this test the glass was completely destroyed. Only one corner shows no fracture and glass is opaque over the majority of its surface. Fractures consisted of combined radial and circumferential forms, thoroughly intermixed so as to lose their identity. Face plate was not seriously damaged other than minor craters reaching through the first or ⅛-inch layer. The entire second portion of the glass in the ½-inch layer was completely smashed out. Layers Nos. 2, 3, and 4 of plastic were smashed loose, permitting the glass to be propelled through the back over an area of a circle having a diameter of approximately 5½ inches (Fig. M). The plate of glass before firing weighed fifteen pounds six ounces and was reduced by the impact about fourteen ounces. This thickness will not stand concentrated machine-gun fire from a submachine gun, and if used for protection of this nature would be extremely dangerous.

The final shot penetrated through the first and second layers, the bullet losing its original identity and leaving a section of the jacket and core weighing approximately 115 grains imbedded in the glass. Experimental firings would indicate that concentrated fire from the automatic pistol using this cartridge would result in similar destruction.

A SIMILAR test was conducted using the same submachine gun and Remington standard commercial ammunition having a 230-grain metal-jacketed bullet. Almost the same type of pattern shot was on the glass plate to form circle having a diameter of 5 inches (Fig. J). The glass was completely broken up but by no means as severely as in the previous test, indicating a tremendous increase in power in the Western Super-X Metal Piercing load over the standard cartridge. The glass plate in this case lost only about one ounce in weight. Slight craters were smashed out on the ⅛-inch face plate around each shot, with radial fractures from all shots to the outside edges of the glass. Damage was quite severe on second or ¼-inch plate and most severe on the ½-inch center plate.

Area of destroyed glass which is completely opaque has a diameter of about 8 inches. There are other portions of this glass through which visibility is practically nil. The final or back plate was severely damaged, although it apparently "held". Some fine glass was broken loose (Fig. K). This glass would not seem to be sufficiently resistant to the concentrated fire of the submachine gun to be considered safe, even with standard loads. Tiny glass particles were imbedded in the wood backstop located 15 inches away and would cause severe damage in striking the face of a person behind the protecting medium.

Tests have been conducted using Hi-Resist Multiplate having a thickness of approximately 1⅝ inches. The .357 Magnum, due to its tremendous effect on Super-Multiplate was used and in this case proved that the glass will hold this extra heavy load. Even in this thick glass, the fractures appeared more severe than in any other handgun cartridge tested (Fig. C). The bullet completely disintegrated on the surface and did not eat through the first layer of plastic. A small amount of plastic was chipped out at the point of impact and slightly powdered. The quantity of glass removed was insufficient to respond to efforts to weigh, and probably was less than half an ounce.

A slight crater was found in the face of the glass having a diameter of about 3 inches. The top surface of the ¼-inch glass was radially fractured on the side, top, and bottom. No fractures extended to the corner of the glass sample. Very few of the fractures on the face plate extended clear to the edges of the sample. The second plate showed the same type of fractures as the first, but this ¼-inch plate was fractured in places where the face plate was undamaged.

The third or center plate bore the brunt of the shock delivered by the bullet. It showed severe fractures extending radially to the edges of the plate, although they do not extend into the corner. Glass is completely shattered approximately 6 inches wide and 8 inches high, although certain severe fractures extended the entire width of the plate. The fourth plate also shows complete fractures over about the same area, increasing in size over the largest sheets. It also is more completely broken up. There was no leakage of any shattered fragments due to the retaining effect of the plastic.

The back plate, having a thickness of ⅛ of an inch was also severely fractured in certain spots and was roughened to the touch of the hand in four places, approximately 2 inches apart (Fig. D). No glass left this back plate, and while many radial fractures extended to the edge of the glass, this does not appear to be badly damaged, the inner section taking most of the shock.

AMONG the rifles tested at twenty-five feet was the .220 Swift, Remington ammunition, 48-grain soft-point bullet, with a special, heavy-barrel experimental rifle; length of barrel 28 inches, muzzle velocity 4135 f.s. One shot was fired to test the comparative shock of the .220 Swift. Laboratory tests show that where the standard Springfield rifle cartridge, known as the Mark I load, with its 173-grain boat-tail bullet merely makes a smear of copper on the armor-plate backstop in the disjunctor circuit of modern chronographs, this tiny, ultrahigh velocity bullet will eat craters almost ¼ inch deep in the alloy steel.

The Hi-Resist Multiplate sample weighed twenty pounds, two ounces before firing, and after firing nineteen pounds, eight ounces—showing a loss in weight of ten ounces. The shot struck about 1 inch from dead center of glass and blew a crater through the first layer of plastic ¼ inch deep to a diameter of about 2 inches, chipping all glass from the plastic over this area (Fig. N). It was then tapered up to a major fracture and most glass was removed over a diameter approximately 4¼ inches. A complete hole was blown in the plastic first layer 1 inch in diameter and glass was blown out of the second ¼-inch layer to a diameter of 1½ inches, pulverizing the edges at this point.

The second layer of plastic also was completely disintegrated to a diameter of ⅜ of an inch, exposing lead-smeared surface of the central portion of the glass, which, although pockmarked slightly and more or less pulverized, seems to have remained intact and offered a flat surface. This leaves a crater having a depth of approximately ⅝ of an inch from the face of the glass plate. No other bullet tested showed an effect comparable to this. No other blew a crater penetrating into the second layer of plastic.

On the back of the glass a peculiar effect was noticed (Fig. O). The force of the shot bulged the thick central plate although it apparently lost little of its contents. It did, however, completely remove a large section of the fourth and fifth plates of glass opposite the point of impact. A large section of glass having a diameter of about 3½ inches, comprising the final layer of plastic between the fourth and fifth layers of glass was blown completely out. This contained a considerable portion of powdered glass and a tremendous amount of powdered glass fragments was blown out with it. Radial fractures at this point are also extremely severe.

Circumferential fractures on the back plate have a diameter

of approximately 7½ inches. The layer of plastic between the thick center plate and the fourth glass plate appears to have held—the only thing which prevented complete penetration of bullet and removal of plastic. The glass was chipped from the back of this layer of plastic to a diameter of 2¾ inches, almost perfectly circular and funneling out through that ¼-inch layer of glass to a diameter of 4 inches. By the time it reached the next layer of plastic the glass appeared to be practically powdered as it is so finely broken up that no other fracture can be noticed except under a powerful magnifying glass. The glass turned almost pure white due to the pulverizing effect. The muzzle energy of the .220 Swift is only 1830 foot pounds, but the great shocking effect is created by the ultrahigh velocity.

THE final test was conducted with the Springfield, using Hi-Power Multiplate, having a thickness of 2.165 inches. Standard Frankford Arsenal Mark I load, manufactured in 1927 was used. Muzzle velocity, 2700 f.s. Nine-degree boat-tail bullet, full metal jacket. Weight of bullet 173 grains. Range 25 feet. The bullet appears to have been disintegrated completely upon impact. Plastic was removed completely from the first layer in the form of an irregular rectangle about 1¾ inches long and 1¼ inches wide (Fig. P).

Practically all glass was removed from this layer of plastic over a circle having a diameter of about 2½ inches. Most glass was removed from the crater to a depth of 5/16 of an inch. The shape of the nose of the bullet was imbedded in the thick second plate of glass. No trace of the bullet jacket could be found in the vicinity. The blow delivered a tremendous shock to the plate of glass, showing miscellaneous radial and circumferential fractures completely intermixed—the circumferential fractures turning outward to a finer diameter than at point of impact. General type of fracture is along these lines. Glass was badly broken up but held bullet, shedding only a small quantity from the rear side. Diameter of the major fracture is about 8 inches. At this point the glass is in good condition. Fractures get worse as the depth increases.

Viewed from the back, the glass is severely bulged and the plastic cracked open, although probably not more than one-quarter ounce of glass left the back of the plate. The plate weighed about twenty-seven pounds and lost about three ounces.

Circumferential fractures indicate the major shock covered a diameter of approximately 7½ inches and the minor shock, 8½ inches. This glass will hold the Mark I load in the Springfield or in machine rifles, such as the Browning and Colt Monitor.

Thus it will be seen that bullet-resisting glass does offer a certain amount of resistance, but not one hundred per cent protection against all bullets.

SCHOOL OF AVIATION ORDNANCE AT LANGLEY FIELD

SPECTATORS at the public bombing and gunnery exhibitions of the GHQ Air Force which are held occasionally at Plum Tree Island, Va., and Muroc Dry Lake, Calif., are always thrilled by the downward drop of the missiles and the curving trajectories of the machine-gun tracer bullets. They respond with enthusiasm to the detonations and dust clouds that follow each bombing salvo. But how many of them realize the patience, skill and back-breaking labor that go into the loading, fuzing, and delivery of the blunt-nosed missiles?

All of the preliminary work at the six air bases of the General Headquarters Air Force, except the actual loading of the bombs into the airplanes, is performed by the six platoons of the 10th Ordnance Service Company, commanded by Lieut. Col. Russell L. Maxwell, Ord. Dept. The headquarters and the first platoon of the company are stationed at Langley Field, Va. To further the training of these Ordnance enlisted men, the School of Ordnance Aviation has been established at Langley Field. The object of the school will be to give initial training in their assigned duties to the enlisted men of the six GHQ Air Force Ordnance platoons.

This is a special project of the 10th Company, organized last January by the War Department at the recommendation of Maj. Gen. Frank M. Andrews, commander of the GHQ Air Force. Colonel Maxwell has selected Capt. Edward P. Mechling, Ord.

Photograph by U. S. Army Air Corps.

HANDLING A 2000-POUND BOMB AT LANGLEY FIELD

Dept., as the school director. Enlisted men will come to the school by air from all GHQ Air Force units to study under the guidance of some of the outstanding Ordnance specialists on the Atlantic Coast. One student each will come from March Field and Hamilton Field, Calif., Selfridge Field, Mich., Mitchel Field, N. Y., and Barksdale Field, La.; four will come from Langley Field. Three sessions will be held in the 1937-1938 school year, with classes beginning in October, January, and March. An entirely new group will comprise each class. There will be no school in December. The final course will be completed in April to enable the entire 10th Ordnance Company to be available for spring exercises of the GHQ Air Force units.

Captain Mechling comes to Langley Field from the directorship of the Automotive and Military Departments of the Ordnance Field Service School, Raritan Arsenal, N. J. He states that the aviation Ordnance students will have a very intensive scholastic schedule, compressed as it is into two months. Nearly eight hours a day will be spent in the classroom. But work will not be limited to the classroom. Every Ordnance facility of Langley Field, the largest air base in the Army, will be at the disposal of the students. Langley Field has a well-equipped Ordnance warehouse. The only subjects taught will be those dealing directly with aviation ordnance. These will include theoretical and practical training in the storage of bombs, fuzes, pyrotechnics, small arms, ammunition, and machine guns. Subjects of principal interest will be small arms and ammunition.

In addition to Captain Mechling, the faculty will include Mr. Thomas Gaines of Langley Field, instructor in ammunition, inspection, storage, and surveillance; Technical Sergt. Robert Tokely, formerly of Raritan Arsenal, who will teach "Ammunition, General," and Staff Sergt. George Amold, instructor in "Small Arms."

Implements of warfare that will be taught at the school are the caliber .30 rifle, the caliber .45 automatic pistol, pyrotechnic projectors, Browning aircraft machine guns calibers .30 and .50, Browning machine gun of the caliber .30 type for ground service, the Winchester and Remington shotguns and the caliber .22 rifle. Explosives and ammunition used in the military service will form an interesting part of the curriculum. This will embrace small arms, trench mortars, aircraft bombs, and artillery ammunition in the introductory phase of the subcourse.

Ordnance Field Service

ORDNANCE SERVICE IN THE CORPS, PART I

BY LIEUT. COL. RAYMOND MARSH, *Ord. Dept., U. S. Army**

IN THE series of articles published thus far in this department, an effort was made, first, to paint a broad general picture of the Ordnance Department, its functions, organization, and operations; then to discuss the general operations of Ordnance Field Service in its two general fields of activities; *i.e.*, in the zone of the interior and in the theater of operations; and finally to carry the discussion of Ordnance Field Service activities down through the principal echelons of the Army's tactical organization, together with a discussion of timely problems and subjects of major importance.

Accordingly, we have covered the "Organization and Operation of the Ordnance Department," (ARMY ORDNANCE, Vol. XV, Nos. 89 and 90); "Ordnance Activities in the Zone of the Interior," (Vol. XVI, Nos. 91 and 92); "Ordnance Activities in the Theater of Operations," (Vol. XVI, No. 93); "The Infantry Division Ordnance Maintenance Company," (Vol. XVI, Nos. 94 and 95); "Army Ordnance Service," (Vol. XVII, Nos. 99, 100, and 101); the general subject of "Ammunition Supply," (Vol. XVI, No. 96, and Vol. XVII, Nos. 97 and 98); and Ordnance "Field Service Problems," (Vol. XVII, No. 102 and Vol. XVIII, Nos. 103 and 104).

Ordnance field-service activities in the division and the army having been treated there remain to be discussed only the Ordnance activities in the third of the army's principal tactical echelons—the corps.

Ordnance field-service activities in the division were covered first because the author firmly believes that this service constitutes the backbone of Ordnance service for the army. Army Ordnance service was discussed next because the army is the fundamental unit of strategic maneuver, the largest self-contained unit with territorial, tactical, administrative, and supply functions.

It is altogether logical, and perhaps correct, to defer a discussion of Ordnance service in the corps until after the division and the army have been covered. A corps, it must be remembered, according to our present concept of the relations of the division, corps, and army, is primarily a tactical unit of execution and maneuver with administrative and supply functions for its own organic corps troops alone, except when acting independently. Consequently, when a corps is acting as part of an army, Ordnance service in the corps resembles that in the division and, in fact, is little different. When a corps is acting independently, it becomes in reality a small army and has imposed upon it all the functions of an army; the deficiencies of its organic service troops are eliminated by reënforcing service elements from the army, or GHQ reserve.

WITH reorganization in the air to the extent that it is at the present time, it may be futile to discuss the duties of any staff officer or the functions of any service on the premises of the present concept of organizational relations or tactical organization. When the War Department makes known the recommended organization of the corps and the army, on which a reorganization board now is working, we may find that the division, corps, and army are so changed in their relations, and the higher echelons so materially changed in their organization, that our present ideas regarding Ordnance service therein may be entirely wrong. Nevertheless, I maintain that if we fully understand how such service was rendered under the old order, what the missions were, what facilities were available to effect these missions, and how these missions were accomplished, it will be easier to adjust our knowledge to the new order than to learn it fresh from the ground up. Consequently, I propose to discuss Ordnance service in the corps on the basis of the existing organization and our present concept of the relations between the corps and the division on one hand, and the corps and the army on the other.

The basis of Ordnance service in an army corps lies in the obligations imposed upon the corps Ordnance officer. These obligations are set forth in the current edition of the Staff Officers' Field Manual. That enumeration of duties has been repeated so frequently in these columns that it will not be repeated again here. In addition, the Manual for Commanders of Large Units sets forth the following:

"Par. 24. Administrative Functions of the Corps: The corps, being primarily a tactical unit, has but few administrative responsibilities. It is responsible for the supply of corps troops. . . . For the divisions, as well as corps troops, it is responsible for the allocation to them of such Class IV supplies as are closely related to the tactical mission of the corps. This concerns primarily ammunition and engineer supplies."

"Par. 25 *b*. Usually the corps as part of an army operates only the following establishments: . . . (3) Ordnance heavy-repair shop. . . . (6) Distributing points for corps troops. . . ."

"Par. 37. General Functions and Responsibilities of the Chief of a Service on the Staff of a Commander: The chief of a service on the staff of a commander is the representative of his service at the headquarters concerned. He renders advice on matters pertaining to his service and is responsible to his commander for the proper operation in accordance with the orders and directives received. Within the scope of these orders and directives and within the limitations of the resources at his disposal, each chief of service has complete initiative in insuring the best possible performance of his mission.

"Each chief of service commands or controls only such personnel and units of his service as are not assigned or attached to subordinate units. He has authority to make such technical inspections and call for such technical reports, on matters pertaining to his service, as are necessary to insure the proper execution of the plans of the commander. Matters concerning general routine and technical details are usually handled through personal conferences, but all other instructions must be issued through the proper channel of command.

"The responsibility of each supply service, with respect to each element and each item of supply with which charged, must be definitely fixed. Itemized lists known as procurement lists and storage lists are therefore used to indicate to the various services the items they are required to provide.

"The general functions of a chief of a supply service on the staff of a commander may be summarized as follows: (*a*) The anticipation, provision for, and distribution of supplies, for which responsible, in the amounts and of the character required at the time and place they are needed. (*b*) Keeping the data as to the status of supplies and equipment pertaining to a service. (*c*) Supervision of accountability for supplies. There are, in addition, certain duties which relate to the maintenance of matériel after issue, which, when authorized, may be required. These are: inspection to determine care and condition, recommendations as to utilization, and limitation or adoption of measures of conservation."

"Par. 53 *c*. The corps Ordnance officer has direct supervision of the Ordnance activities of the corps, but exercises only technical supervision over divisional Ordnance officers. He is

*This discussion presents the personal views of the author and does not represent official policy on the subject.

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charged with the provision of Ordnance supplies, except ammunition, for corps troops, for the maintenance and availability of the corps reserve of small arms and artillery ammunition, for the control of the Ordnance maintenance facilities pertaining to the corps, and for the establishment and operation of corps ammunition and Ordnance supply depots when so directed. He has available for these purposes the Ordnance companies (heavy-maintenance and ammunition) assigned to the corps."

"Par. 71 *d* (2) (a) (ii) The corps is normally concerned with the supply of its division only to the extent of assurance that the supply is satisfactory. The normal chain of supply of all classes, except certain articles of Class IV supplies which are subject to allotment by corps to the divisions, is direct between the army and the divisions. (iii) Corps duties in ammunition supply: The corps has definite responsibilities with respect to the supply of ammunition, for the reason that requirements are based on tactical requirements and the supply must be organized and administered so as to meet constantly changing and often suddenly increasing consumption."

"Par. 76 *b* (1) Ammunition supply: Requirements in ammunition are based on tactical considerations. The system of ammunition supply must be organized and administered so as to meet constantly changing and often suddenly increasing consumption. The distribution of ammunition must therefore be based on reports of expenditures covering relatively short periods of time, and showing the status of ammunition supply in the various echelons of the command. . . . (5) Provision for and distribution of ammunition to include the operation and maintenance of army ammunition depots, the maintenance of the unit reserve of ammunition in corps and division Quartermaster trains, and the distribution of small-arms ammunition are responsibilities of the Ordnance service. . . ."

BASED on the foregoing, the corps Ordnance officer is specifically charged with the following duties and responsibilities: (1) The command of Ordnance troops not assigned or attached to subordinate units; (2) The supply and maintenance of the Ordnance matériel pertaining to corps troops; (3) Recommendations for the location and operation of corps Ordnance maintenance facilities and the corps ammunition dump, when and if established; (4) Recommendations for the Ordnance parts of the corps plan of supply; (5) The execution of the Ordnance parts of the corps plan of supply; (6) The establishment and operation of Ordnance installations, comparable to those established and operated by an army, when the corps is operating independently.

Although an Ordnance staff officer exercises command only over such Ordnance troops as are not assigned or attached to subordinate groups, his authority, insofar as it relates to their operations and his technical supervision of these operations, is such that he exercises a control that is closely akin to command. We can, therefore, say that the duties of a corps Ordnance officer may be grouped into two general classes: staff duties and control (command?) duties.

Under the first heading he is the adviser to the corps commander and his staff on Ordnance matters and activities; he is responsible for adequate and timely plans for the effective operation of the corps Ordnance service, which plans must include estimates of requirements for Ordnance supplies, personnel, equipment, and facilities. He also is charged with technical supervision and inspection, within the limits prescribed by the commander, of Ordnance activities in lower echelons.

Under the second heading, he is responsible for the efficient operation of the corps Ordnance service in accordance with the plans, policies, and basic decisions of the commander.

The corps Ordnance officer is responsible to the corps commander for the proper functioning of his service and the performance of his duties. While he must delegate many details

to his subordinates for execution, he cannot delegate to, or share with them, his responsibilities to the corps commander. It must be remembered that he is a special staff officer and the operating head of a service. These dual functions are separate and distinct. They involve different functions and activities which must not be confused or permitted to interfere with each other. Especially is this true with respect to dealings with Ordnance officers of lower echelons. Here, the relation primarily should be that of one Ordnance officer on one staff to another Ordnance officer on another staff.

The Ordnance officer must keep the corps commander and his general staff group fully informed as to the condition, capabilities, and requirements of Ordnance service in order that they may have at all times the necessary information on which to base plans and orders. Staff conferences, which include the Ordnance officer, provide a means whereby the corps commander and his general staff group may receive prompt verbal reports as to the condition of the corps Ordnance service. Such conferences promote coöperation by the dissemination of information and frequently settle difficulties before such obstacles have had a chance to affect, adversely, the efficiency of the command.

The Ordnance officer has contacts with all sections of the general staff group, depending upon the nature of the subject involved; however, most of these are with the G-4 section.

Having thus surveyed the duties of the corps Ordnance officer and the scope of the corps Ordnance service, let us examine now what facilities are available to the corps Ordnance officer for the accomplishment of his missions, and how they may be employed in rendering the prescribed service.

The corps Ordnance office, provided as part of corps headquarters, consists of the corps Ordnance officer, one commissioned assistant, usually a captain; two noncommissioned officers of the first three grades; and two privates employed usually as clerks.

In the corps special troops, there is an Ordnance heavy-maintenance company and an Ordnance ammunition company. The heavy-maintenance company at the present time consists of 11 officers and 273 enlisted men (T/O 11*2* W) and attached medical personnel, together with a number of special technical vehicles, such as machine-tool trailers or trucks, spare-parts trucks, cargo trucks for company baggage and other organizational equipment, motorcycles, and passenger transportation. The ammunition company at the present time consists of 6 officers and 164 enlisted men with merely sufficient transportation to carry the company baggage and other organizational equipment.

In the corps artillery brigade, there is an Ordnance medium-maintenance company organized as prescribed in T/O 12 W, but with a somewhat different distribution of personnel between the several operating technical sections and with slightly different equipment in order to fit it better for its special mission. This being an Ordnance troop unit assigned or attached to a subordinate unit of the corps, the corps Ordnance officer can exercise no direct control over it, because of his position. Usually, however, under the authority of the corps commander, full coöperation and close coördination can be effected between this maintenance unit and other maintenance units of the corps, including not only the heavy-maintenance company of the corps itself, but also the maintenance units of the component Infantry divisions of the corps.

Before we discuss how the corps Ordnance officer utilizes these agencies to discharge the missions of corps Ordnance service, let us recall that, like the army Ordnance officer, he must both plan and operate; that due to the tactical importance of the corps he primarily must be a planner; that the actual execution of his plans must be delegated to subordinates, and that the effectiveness and efficiency of this delegated execution must be determined by inspections. And let us recall that, like a division Ordnance officer, he has the functions of technical inspections, supply, maintenance, salvage, and, under certain circumstances, demolition of Ordnance items. (*To be continued.*)

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AOA

Drama!

THE EVOLUTION OF FAST TANKS—A DRAMA IN 3 ACTS

BY LIEUT. COL. R. SEARS, *Ord. Dept.*

DRAMATIS PERSONÆ (ALL IMAGINARY)

Gen. High Command, generalissimo of the armed forces of Belgardia.
Gen. Old Fossil, strictly conservative.
Gen. Old Philosopher, who sees the handwriting on the wall.
Col. Design & Development, who has the unpleasant task of giving all what they want; so he tries to make them believe they don't want it.
Major Veteran, who talks from experience.
Capt. Younger Generation, who is not bound by precedent.

ACT I

SCENE: *The Generalissimo's office in the War Department where a conference is being held on the subject of tank development, A.D. 1920.*

General High Command. Gentlemen, I've called you all together to discuss the matter of tank development, particularly as to the speed we should endeavor to obtain since it has an important bearing on tactics. Major Veteran, you commanded a battalion of tanks in the war and I should like to hear from you.

Major Veteran. General, it is my fixed opinion, based on actual war experience, that the maximum speed tanks ever will be required to make will be the speed of the infantry soldier double-timing in field equipment, since the tank is a shield for the foot soldier when not being used as a supporting weapon. Therefore, ten miles per hour is the maximum we should shoot for.

General High Command. Colonel Design & Development, as an expert in automotive engineering, what is your opinion?

Colonel Design & Development. General, no track-laying vehicle has ever been built to run at greater speed than four miles an hour. Even at that speed, reliability is almost impossible.

Captain Younger Generation. General, if I may be permitted to add a thought to this matter: What about the automobile? When it first came out it could hardly keep abreast of a good horse, provided it didn't break down, and now we think nothing of driving forty-five miles an hour for two hours at a stretch.

General Old Fossil. I had a speed-crazy chauffeur during the war who told me my car was capable of making sixty miles an hour on the level, but I never permitted him to drive over thirty-five. This thought of speed in tanks is a result of war hysteria.

General Old Philosopher. Gentlemen, I've seen a lot of trends that ran on the rocks and many more that led to unexpected heights. What seems a craze today may be a demand tomorrow, and the engineers may have to supply it and with a headache!

General High Command. Colonel Design & Development, please convey to your chief that it is my decision to attempt what seems at the moment impossible of accomplishment. I therefore direct that every effort be made to so increase the speed of tanks that foot troops will have to throw away their packs and run like hell to keep up. Meeting adjourned!

(Exit all conferees. Colonel Design & Development stops to buy a package of headache tablets.)

ACT II

SCENE: *Same as Act I, A.D. 1930.*

General High Command. Gentlemen, this is the first time we have assembled in ten years. Colonel Design & Development, will you tell us what has been accomplished in that time?

Colonel Design & Development. We now have a tank more reliable mechanically than the war tanks and which can attain speeds of more than twenty miles an hour, but, General, I think we have gone too far. We should pause in our lust for power. Our tacticians have not been able to keep abreast of such speeds and most of them are agreed that even though attainable they could never be used on a shell-torn battlefield.

Captain Younger Generation. There is talk, gentlemen, that a certain inventor is bringing out a tank that runs on wheels at seventy miles per hour and on tracks at forty miles per hour.

Colonel Design & Development. That is correct, but I have been advised by some of the country's outstanding automotive engineers that dual-purpose machines are impracticable.

General Old Philosopher. Yet we have multipurpose machine tools, hydroplanes, and I understand one nation has successfully built a tank that runs in water and on land. It seems to me, gentlemen, that this certain inventor has given us something to ponder over since such speeds would enable a fleet of tanks to quickly reënforce a threatened locality miles away and possibly turn defeat into victory.

General Old Fossil. But such speeds are unattainable in convoy or in congested areas.

General Old Philosopher. I stood on the main street of one of our greatest cities the other day at the most crowded hour and watched company after company of the fire department go by at forty-five miles an hour. I was struck by two things: the skill of the traffic police and the discipline of the driving public. I could not help but visualize a war emergency in which, instead of roaring fire trucks, it would be antiaircraft artillery going to repel an invasion by aircraft or a battalion of tanks speeding to support a threatened part of the defending lines. In such a case there would be more than a few seconds warning. The entire traffic force would be out; the line of march would be entirely cleared and I'm very much afraid a lot of angry civilians would arrive late at their destinations; but, gentlemen, "war is hell."

Colonel Design & Development. But, General, we've only now accomplished speeds of twenty to twenty-five miles an hour and my head is already almost split.

General Old Philosopher. Let it split, Colonel. Two heads are better than one.

General High Command. Colonel Design & Development, I appreciate your predicament, but if it hadn't been for you and your kind we would still be in the horse-and-buggy days. Go back, therefore, and tell your chief that we now want tanks that can surpass in speed the fastest fire trucks. Meeting adjourned!

ACT III

SCENE: *A room in the Army and Navy Club of Belgardia, A.D. 1950.*

General High Command (Retired). It was too bad about Old Fossil, wasn't it?

General Old Philosopher (Retired). I hadn't heard.

General High Command. He was blocking traffic as usual, told his chauffeur not to drive over 150 miles an hour, was hit from the rear and knocked into the ditch.

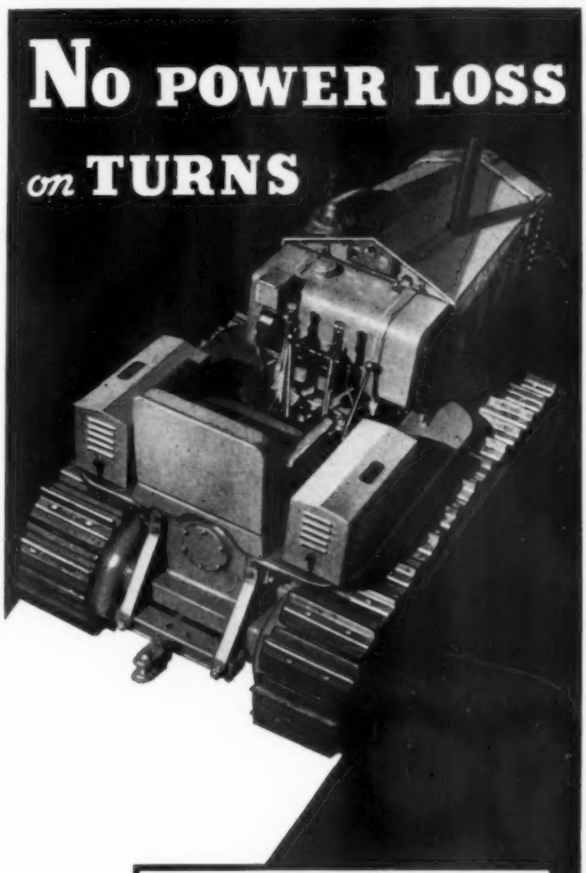
General Old Philosopher. Too bad, too bad. These modern roads are a menace and will continue so until minimum speed limits are properly increased.

(Enter Colonel Younger Generation, Commanding Officer 20th Mechanized Cavalry, just arriving from a conference in the War Department.)

Colonel Younger Generation. Gentlemen, the decisive blow in the Red-Blue War has just been struck. The Blues brought in 1000 tanks which had moved 500 miles in five hours and cut the victorious Red lines at the bloody salient. They were just in time to change the whole complexion of the war.

General High Command. What delayed the tanks, Younger Generation?

Colonel Younger Generation. Four bridges were out, sir.



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AOA

Chronicle

ASSISTANT Secretary of War, Louis A. Johnson made the address of welcome at the opening exercises of the Army Industrial College, Washington, D. C., on September 1st. Fifty-seven officers from the Army, Navy, and Marine Corps compose the new class, including the following nine officers of the Ordnance Department: Lieut. Col. Archie S. Buyers, Lieut. Col. Carl A. Waldmann, Maj. John Huling, Jr., Maj. Henry E. Minton, Capt. David J. Crawford, Capt. William J. D'Espinosa, Capt. Gerson K. Heiss, Capt. Lawrence C. Leonard, and Capt. Albert S. Rice.

Secretary Johnson said in part to the incoming class: "To you, it is hardly necessary to say that the preparedness of industry for war is as necessary to ultimate victory as the mobilization of man power. It may still be true that men will spring to arms overnight, but without their rations, their equipment, their arms, and their ammunition, they may prove wholly ineffective. The war plans of today must consider the industrial efforts of the whole people, the civilian as well as the military demands, and their proper coördination toward success in the field of battle."

Rear Admiral A. B. Cook, chief of the Bureau of Aëronautics, Navy Department, speaking during the Air Defense Day program sponsored by the Cleveland Women's Chapter of the National Aëronautic Association said: "The present naval aviation policy is to build and maintain aircraft commensurate with a treaty Navy. This calls for a maximum of 2000 planes by 1941. As chief of the Bureau of Aëronautics of the Navy Department, I am glad to be able to say that this program is proceeding very satisfactorily. There are now actually on hand over 1000 modern airplanes and an additional 800 are either on order or funds available for the purchase. When the entire program is completed, we will have 68 combatant naval squadrons, of which 39 will be ship-borne, 22 tender-based and 7 attached to the fleet Marine force."

MAJ. GEN. FRANK M. ANDREWS, commanding the GHQ Air Force, in a speech before the same chapter of the National Aëronautic Association said in part: ". . . . an air attack on a large scale can only be delivered by an enemy who has succeeded in establishing air bases on or nearby this continent, or on aircraft carriers. Fortunately, the establishment of such bases is a task which cannot be completed overnight; therefore it is not reasonable to suppose that it could be accomplished without our knowledge. And therein lies the solution to our air-defense problem. The answer is clear: In addition to a necessary force of pursuit, build up an effective force of bombers of sufficient range to attack any point on or near this continent which might be selected as a base by the enemy. . . . The sooner we can acquire an effective number of bombers of this (the "Flying Fortress") type, the sooner will the GHQ Air Force be capable of protecting the nation against the dangers of a modern air attack. . . . It should be remembered, however, that our air security depends upon the peace-time existence of an effective force of airplanes of the selected type; manned by trained personnel; armed with modern equipment and strategically located for the task in hand. Such must be the aim of the GHQ Air Force, your weapon of air defense."

Designed to meet the speed and fire power of the "flying-fortress" type of bomber, a new multiseater fighter is being

tested by the Army. The twin-engined, low-wing craft has its propellers behind the wing for greater efficiency and in order to give the wing gunners—one on either side—an uninterrupted field of fire forward. It was built by the Bell Aircraft Company of Buffalo and is known as the XFM-1. The fighter mounts six guns, carries light bombs, and accommodates a crew of five—pilot, copilot, navigator, radio operator-gunner and two outboard wing gunners. In addition to other innovations, the ship is provided with wing flaps to reduce landing speed and an auxiliary power plant to take the load off the driving motors and permit radio communication if the main power plants fail. Crew compartments are electrically heated to protect the personnel at the craft's fighting ceiling of thirty thousand feet.

An automatic radio-controlled landing system for bringing airplanes safely to earth without human hands at the controls has been designed by Capt. Carl J. Crane, director of the Instrument and Navigation Laboratory at Wright Field, Ohio, and successfully tested by his coworker, Capt. George V. Holloman, assistant director of the laboratory. Mr. Raymond K. Stout, project engineer and Mr. C. D. Barbulesco of the Signal Corps Aircraft Radio Laboratory also designed various units of the automatic control apparatus.

REPRESENTATIVE Dow W. Harter of Ohio, chairman of the Subcommittee on Aviation of the House Military Affairs Committee writes in a recent issue of *National Aëronautics* in opposition to a unified air service to rank equally with the War and Navy Departments. "Let me repeat," he writes, "that unity of command is a tremendously important factor in the winning of any war. As to the charge of duplication between the Army and Navy, the creation of a separate air force would in no way answer this charge. Such a third independent agency would of necessity require the duplication of all those services such as the Quartermaster, Finance, Medical, Ordnance and others now performing services for the Army and Navy air elements."

This year's classes at the Army War College were opened formally on September 1st. The student body is composed of eighty-nine Army officers, four Navy officers and two Marine Corps officers. The Army group includes two Ordnance officers—Lieut. Col. Gladeon M. Barnes and Maj. Clyde H. Morgan.

With hostilities in China endangering the United States' tungsten supply, American scientists again are faced with the problem of providing a satisfactory substitute for this metallic element so essential to industry and national defense. While to date China has made no formal announcement that her tungsten exports will be cut off, the Bureau of Mines in Washington has announced that the central Wolfram administration has made no sales for some time past. It is believed by some that this move is aimed at cutting off Japan's supply of the element. Tungsten is, of course, largely employed in the manufacture of incandescent lamps but it also is used as a ferro-alloy and is essential in the manufacture of tool steels. While the great portion of the U. S. supply comes from China, smaller quantities can be obtained from India, Burma, and Bolivia. There are small tungsten supplies in Colorado, Nevada, and California.

A CONTRACT totaling $4,153,938.06 recently was awarded by the War Department to the Pratt & Whitney Division of the United Aircraft Corporation for 455 aircraft engines with spares. Three hundred and fifteen of these engines, rated at 1000 horsepower, are of the twin-row Hornet type and were procured for the 216 P-36A airplanes being constructed under a contract recently awarded to the Curtiss-Wright Airplane Corporation of Buffalo, N. Y.

ADDENDUM: The name of Capt. Otto M. Jank, Ord. Dept., should be added to the list of Ordnance officers who were graduated from the Army Industrial College in June 1937. This list appeared in the September-October 1937 issue of ARMY ORDNANCE, page 112.

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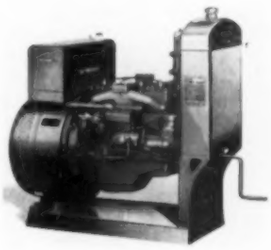

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AOA

Book Reviews

Twenty Years As Military Attaché. By Col. T. Bentley Mott. New York: Oxford University Press. $2.50.

WHY a publisher should put such a dull title on so vibrant a work is a puzzle to this reviewer. The book is not a mere biography, nor is it limited to the scope apparent in the title. It is an acute and astute record of one of the most interesting and eventful periods in American foreign relations. The genius which the author displayed in compiling the material in book form is surpassed only by his genius as a living part of that period.

The fact that he bore the name of military attaché is only incidental. He lived among and knew the people who made up the background of the events that, beginning with American amateur foreign affairs in the nineties and leading up to the World War, formed the directive force of that conflict and the subsequent events that now place America in a strong position amid the tremendous forces that are shaking the political world today.

If one were to enumerate the parts of the book that should be read by every thinking American it almost would be necessary to transcribe the entire work. The background given in the description of the condition of our Army in the nineties and early part of this century, depicts the mental condition of America itself at that time. Great lessons for our future guidance can be learned from the chapters that cover how we came to the aid of Japan, how and why the Root mission to Russia failed, how Pershing and his army were involved in foreign intrigue in France, and the scheming behind the Armistice. This is no "gone-with-the-wind" treatment of past events. It is a realistic development of the rise of a whirlwind. G. S. B.

The Private Manufacture of Armaments. By Philip Noel-Baker. New York: Oxford University Press. $3.75.

TAKING this volume and its author in a most objective manner we find: (1) Mr. Noel-Baker was a member of the British delegation to the Peace Conference, 1919; Parliamentary Private Secretary to the Secretary of State for Foreign Affairs, 1929-1931; Personal Assistant to the President of the Disarmament Conference, 1932-1933. The *Sunday Times* (London) contained this note on his life: "Just when Noel-Baker's youthful career was at its zenith there came the war. He is a Quaker and felt that he could not fight; so, largely at his own expense, he equipped the first Friends' Ambulance Unit. Taking his turn as driver he guided the Unit wherever the fighting was most severe; and, when he likes, he can wear the Mons Star, the Italian Silver Medal for Military Valor and the Italian Croce di Guerra. In the course of his driving he fell in love with and married his present wife who was working with him in the ambulance." So there is the Friendly viewpoint.

(2) Viscount Cecil has written a prefatory note to the book. The concluding sentence of the note reads: "Every one who cares for peace should read it, and I cannot doubt that impartial readers will be convinced that private manufacture of armaments should be brought to an end without further delay." So there is the Cecilian exhortation.

(3) The publisher's fly leaf, the second sentence of which reads, "The world will spend $15,000,000,000 for armaments in 1937"—which, of course, is not true. Sensationalists have a way about them of using terms indiscriminately. We doubt that

more than twenty per cent of all world expenditures for armies and navies are for "armaments."

All this we were told before settling down to read the text. And here's what happened as we read. We labored through the first 128 pages of a decidedly one-sided but elaborately documented indictment until we came to the following: "People who can draw such a lesson from the World War (that preparedness is one of our strongest guarantees of peace) can hypnotize themselves into believing anything." This reviewer—a confirmed, dyed-in-the-wool, enthusiastic, shoutin' hypnotic could go no further! L. A. C.

SANTA ANNA. By Wilfrid Hardy Callcott. Norman, Okla.: University of Oklahoma Press.

TO the average American, the name of Santa Anna recalls the heroic defense of the Alamo, the victory of the Texans at San Jacinto, and the battle of Buena Vista. But these events were just a few of the high lights in the life of a man whom the author has termed "an enigma who once was Mexico."

Born in 1794, Santa Anna—or to give him his full name, Antonio Lopez de Santa Anna—entered the Mexican Army as a cadet in 1810 and from then until his death in 1876 his career was a continuous series of campaigns, battles, political intrigues, retirements, revolutions, rebellions, exiles, victories, and defeats. One month he might be the idolized hero of the populace; the next month he would be the hunted traitor of his country. Likewise, he oscillated, pendulum-like, from ruler and dictator, to exile. Truly, he was the supreme political and military character of Mexico during the first three decades of its national existence, from 1823 to 1855.

The book is written with scholarly attention to detail and accuracy. If any criticism may be voiced, it would be to the effect that the completeness of detail regarding Santa Anna diminishes the importance of the historical events in which he played, so frequently, a leading part. The result of this mass of detail, however, is that the book is a splendid biography of its central figure. The scope of the research behind this work is indicated by the 11-page bibliography which is included. The book is to be commended to students who are interested in the life of the man who was indeed the spirit of Mexico during the middle years of the nineteenth century. R. M.

AUTOMATIC PISTOL MARKSMANSHIP. By William Reichenbach. Marines, N. C.: Small Arms Technical Publishing Co. $1.50.

THIS is the third manual to be written by the author—the first being "The Elusive Ten," the second its sequel, "Sixguns and Bullseyes," and the third the one reviewed here. This book, comprising fourteen chapters and 140 pages, is well divided in subject matter, and the points which are usually needed by the shooter learning to use the automatic pistol are constantly called to attention. There is no doubt that the author's first love is the "Lueger" (*sic*) pistol. This spelling leads the reviewer to believe that Mr. Reichenbach first really used the *Luger* as a member of the German forces during the recent World War. Many of us would like to have some first-hand information on the results obtained!

Regardless of the impression which this reviewer received from the book, there are many fine and interesting ideas brought out. The need for a new automatic pistol using both large- and small-caliber ammunition and so constructed that it would embody all the good points of the various existing guns, plus a few that do not exist, seems very well taken. Whether or not the arms manufacturers look at it in the same light is something else again. With the cost of tooling, the chances of pistols becoming outlawed, etc., it is problematical whether they could be sold on the idea, but it is always enjoyable to contemplate what we would like to have!

The author is to be complimented for the new ideas presented.

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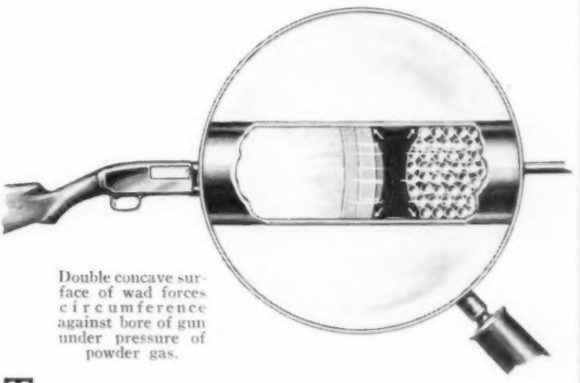

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He has established a style of writing that makes for entertainment—and even argument—but he has not hesitated to state his views, although many readers will not agree with him. But after all, a book should present the author's views and not a collection of thoughts obtained from a perusal of existing texts. Mr. Reichenbach has at least presented his own ideas and thoughts on a subject that interests all shooters and he is to be praised for having contributed something of value to this field of literature. H. E. S.

Chief Flying Hawk's Tales. By M. I. McCreight. New York: Alliance Press.

This is an interesting little volume of some fifty-odd pages setting forth the chief events in the life of an eighty-year-old Indian chief who saw and participated in many of the episodes which were prominent in the relations of the United States with the Indians of our western plains in the several decades following the War Between the States.

Chief Flying Hawk was born in 1852, a short distance from where Rapid City, N. Dak., now stands. He was a Sioux of the Ogalalla clan and was a cousin of Crazy Horse, that doughty Indian warrior who was never defeated in his many encounters with the United States troops.

Chief Flying Hawk was only ten years old when he participated in his first fight—an attack on a troop-escorted "covered-wagon" train in Montana. For about the next twenty years of his life, he seems to have been occupied with numerous horse-stealing raids against unfriendly tribes, fights with settlers, troops, and other Indians, and finally with efforts to settle down as a "reservation" Indian.

The high spot of his career probably was the fight with Custer and the 7th Cavalry. His account of that, however, is too brief and sketchy to tell little more than we already know except a few facts as to the movements of Custer and his troops before they were surrounded.

In addition to the tales of this Indian chief, the book contains some speeches by other chiefs as they protested those actions of our Government and our settlers which make our relations with these same Indians a "century of dishonor." An interesting little book and well worth reading. R. M.

Fortification. By Col. William A. Mitchell. Washington, D. C.: The Society of American Military Engineers. $2.00.

This is the fourth edition of Colonel Mitchell's well-known text first published in 1926. The author is professor of civil and military engineering at the United States Military Academy where the text is used in the course in fortification. It is a revision of other books formerly used in the course and contains data incorporated from texts of the Command and General Staff School as well as certain sections of the Training Regulations.

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THE SHOTGUN. By Capt. J. A. Purdey and T. D. S. Purdey. (Volume 20 of The Sportsman's Library.) London: Philip Allan & Co. Ltd. Obtainable in the United States through Charles Scribner's Sons. $2.00.

THIS book is not intended to be a complete treatise on the shotgun and its use, as the reader is referred many times to the three volumes by Burrard. These, of course, cover the ground more thoroughly, but it can be said that this single volume contains more information, page for page, than many of the other books on the shotgun.

Written by British shooters, it naturally has the British viewpoint, but with the reduction of game in the United States it might be well for our domestic sportsmen to familiarize themselves with the preserve method of shooting game. Indications are that this method, or at least some modification of it, will become the practice in this country.

The first eighty-seven pages are devoted to a description of the shotgun, gun fitting, the shooting school, cartridges, powder, and shot. To cover these subjects in such a small space, the explanations are, of necessity, brief and concise, but such that the novice can get a very good conception of what is treated and with attention can obtain a great amount of information.

The authors then carry the reader into the various phases of shooting as conducted on the British Isles, with a complete outline of the etiquette required so that a shooter, contemplating a shoot in England, could, in a short time, gain all the information required and still feel that he was fairly well informed on the conduct of the shoot. Lovers of the shotgun who wish to inform themselves on British practice, but who have little time to read up on the subject, will find this book a necessity. H. E. S.

ELECTRICAL MEASUREMENTS IN PRINCIPLE AND PRACTICE. By H. Cobden Turner and E. H. W. Banner. Pittsburgh: Instruments Publishing Company. $4.50.

THE object of this book is to give a general account of practically all systems of electrical measurement adaptable for use by engineers and others who are not specialists in the field. The text aims to make available for such infrequent use a broader procedure not involving textbook mathematics essential to the student and research worker. Thus with most of the mathematical proofs omitted, the contents of the volume have been widened in scope to include not only common measurements of current, voltage and power, but other less widely used measurements such as those of speed, temperature, effective resistance, boiler-house measurements, inductance and capacitance. O. E. D.

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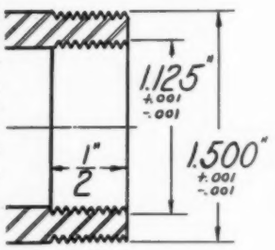

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